PULP&PAPER

1989 NORTH AMERICAN FACT BOOK

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Information in this volume is designed to present a
comprehensive review of the structure and status
of the pulp and paper/board industry of
the United States and Canada. Every effort
has been made to provide accurate data.
To the best of the editors' knowledge,
data are reliable and complete,
but no warranty for this is made.

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NORTH AMERICAN OVERVIEW

North America is the world's most important pulp- and paper-producing region, accounting for about 50% of worldwide pulpmaking capacity and 40% of paper and paperboard capacity.

Paper and paperboard production has just about matched general economic activity during the 1980s. Printing/writing grades have shown strong growth because of the spread of smaller computers and the demand for higher-quality paper in advertising. Packaging grades have shown somewhat slower growth due to inroads by plastics in some market segments. Industry profitability improved strongly during the latter part of the decade, helped by favorable market conditions and the decline of the dollar.

The North American Overview is divided into two sections: United States and Canada. For each country, there is a chapter that examines trends in industry structure, production, exports/imports, prices, profitability, capital spending, capacity expansion, mergers and acquisitions, labor, timber resources, energy use, transportation, and environmental spending and regulations.

Financial data:	All sales and earnings figures are shown in U.S. dollars, unless indicated "C$" for Canadian dollars.
Production data:	All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric. To convert to metric tons—multiply by 0.90718. To convert to short tons—multiply by 1.1023.

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United States:

INDUSTRY STRUCTURE

The U.S. paper industry avoided the well-publicized decline of "Smokestack America" in the 1980s, and it remains a low-cost producer in excellent position to compete at home and in world markets. By closing inefficient facilities, spending intensively to upgrade equipment, and winning concessions from its workforce, the industry in the last decade weathered two recessions and the erosion of its markets as the dollar soared. Tough measures taken during these down periods left companies in generally good competitive health and set the stage for the record earnings that accompanied the weaker dollar and tighter markets of the past three years.

Paper and allied products ranks ninth among U.S. manufacturing industries in value of shipments, according to 1987 data from the Bureau of the Census. The industry's shipments were valued at $110.3 billion in 1987, up 12.7% from the previous year—the largest gain of any industry. Paper now falls behind food, transportation equipment, machinery, chemicals, electrical machinery, fabricated metal products, petroleum and coal products, and primary metals among U.S. manufactures.

PAPER MACHINES IN OPERATION

	Number of machines 1987	1980	1975	Machine capacity* 1987
Newsprint	41	43	38	6,006
Printing/writing	421	452	475	22,077
Packaging	183	205	228	5,492
Tissue	209	236	240	5,505
Total paper	854	919	981	39,080
Unbleached kraft	66	74	69	19,421
Solid bleached	27	30	31	4,735
Semichemical	38	47	51	5,682
Recycled	187	209	244	9,267
Total paperboard	318	360	395	39,105
Total paper and board	1,172	1,279	1,376	75,777

* = 000 short tons.

Source: American Paper Institute.

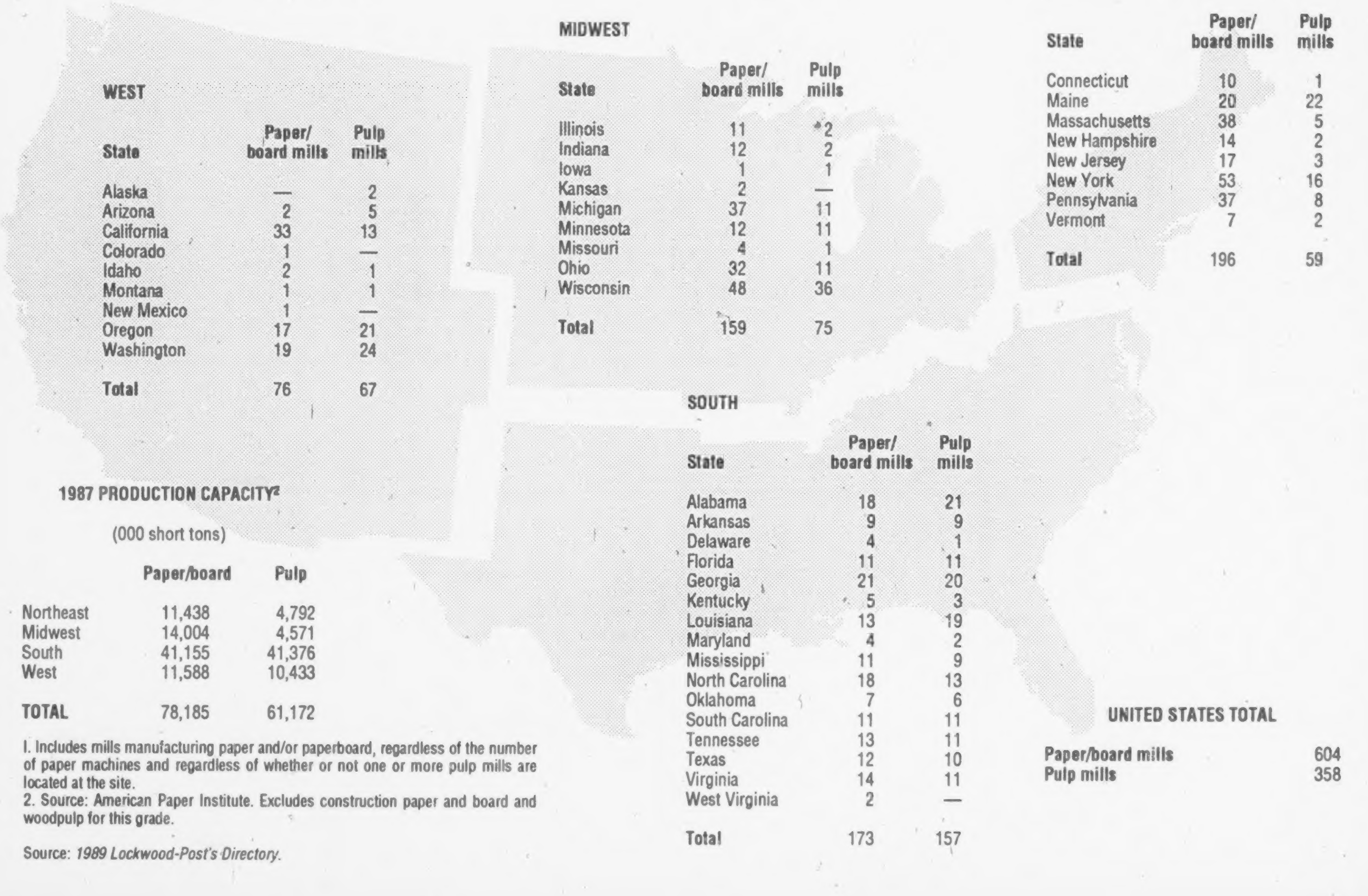
The industry's shipments accounted for 5.3% of total U.S. manufactures in 1987, while its workforce of 680,100 employees accounted for 3.6% of the total U.S. manufacturing industries payroll. During the 1980s, employment ranged from a low of 661,000 in 1982 to a high of 693,000 in 1980. In 1987, paper and allied products employment ranked thirteenth among U.S. manufacturing industries.

Ranked by sales of pulp, paper, and converted products, the largest company in the U.S. paper industry is International Paper Co., with revenues of $8.20 billion in 1988. IP leaped to the No. 1 position with the purchase of Hammermill Paper Co. in 1986. James River Corp., another company that has grown substantially through acquisitions, is second in terms of sales, with revenues of $5.87 billion in fiscal 1989. Tissue and consumer products maker Kimberly-Clark Corp. ranks third with 1988 sales of $5.29 billion, followed by Scott Paper Co. in fourth place with sales of $4.73 billion. Champion International Corp. closes out the top five with pulp and paper sales of $3.98 billion in 1988.

Thirty-three forest products companies made the most recent Fortune 500, a list of the country's 500 largest industrial companies compiled by *Fortune* magazine. Weyerhaeuser Co. ranked 37th on the list, with total sales of $10.0 billion. (Weyerhaeuser's pulp, paper, and converted products sales totaled $3.53 billion—eighth highest among U.S. paper companies.) International Paper ranked 42nd among the Fortune 500, followed by Georgia-Pacific Corp. in 43rd place, Kimberly-Clark in 85th, and Champion International in 91st. Pope & Talbot was the last forest products company on the list, coming in at No. 488.

NUMBER OF PULP, PAPER, AND BOARD MILLS IN U.S., BY REGION

(Number of mill sites)[1]



WEST

State	Paper/ board mills	Pulp mills
Alaska	—	2
Arizona	2	5
California	33	13
Colorado	1	—
Idaho	2	1
Montana	1	1
New Mexico	1	—
Oregon	17	21
Washington	19	24
Total	76	67

MIDWEST

State	Paper/ board mills	Pulp mills
Illinois	11	2
Indiana	12	2
Iowa	1	1
Kansas	2	—
Michigan	37	11
Minnesota	12	11
Missouri	4	1
Ohio	32	11
Wisconsin	48	36
Total	159	75

NORTHEAST

State	Paper/ board mills	Pulp mills
Connecticut	10	1
Maine	20	22
Massachusetts	38	5
New Hampshire	14	2
New Jersey	17	3
New York	53	16
Pennsylvania	37	8
Vermont	7	2
Total	196	59

SOUTH

State	Paper/ board mills	Pulp mills
Alabama	18	21
Arkansas	9	9
Delaware	4	1
Florida	11	11
Georgia	21	20
Kentucky	5	3
Louisiana	13	19
Maryland	4	2
Mississippi	11	9
North Carolina	18	13
Oklahoma	7	6
South Carolina	11	11
Tennessee	13	11
Texas	12	10
Virginia	14	11
West Virginia	2	—
Total	173	157

UNITED STATES TOTAL

Paper/board mills	604
Pulp mills	358

1987 PRODUCTION CAPACITY[2]

(000 short tons)

	Paper/board	Pulp
Northeast	11,438	4,792
Midwest	14,004	4,571
South	41,155	41,376
West	11,588	10,433
TOTAL	78,185	61,172

I. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines and regardless of whether or not one or more pulp mills are located at the site.

2. Source: American Paper Institute. Excludes construction paper and board and woodpulp for this grade.

Source: *1989 Lockwood-Post's Directory.*

The forest products group did very well in comparison with the rest of the Fortune 500, reflecting the tight markets and high prices enjoyed by the industry in 1988. After leading the industrials in 1987, forest products posted gains of 45.0% in profits (third highest among all industries) and 13.8% in sales (seventh highest). Median earnings for the 33-member forest products group were $163 million in 1988 on sales of $1.72 billion. Thanks to high prices for most products and continued strong demand, the forest products group ranked second in return on sales, with profit margins of 8.7% vs 5.5% for the Fortune 500 overall.

International Paper remains the capacity leader in the U.S. industry by a wide margin, producing 6.5 million tons of paper and paperboard and 1.1 million tons of market pulp in 1988. Weyerhaeuser was the largest market pulp producer, with output of 1.5 million tons in 1988.

Stone Container Corp. held second place in paper and paperboard in 1988, with production of 4.5 million tons. Because of a bold series of acquisitions, mostly in the containerboard sector, Stone Container became one of the major success stories of the 1980s, rising to its present position from tenth place in pulp, paper, and paperboard capacity in 1983. Stone diversified strongly into newsprint and market pulp in 1988 with the purchase of Consolidated-Bathurst Inc., Canada's fifth-largest pulp and paper company. The acquisition gives Stone some 7.5 million tons of annual pulp/paper/board capacity, and it makes Stone the third-largest producer of newsprint.

U.S. PAPER INDUSTRY VALUE OF SHIPMENTS RANKED WITH OTHER INDUSTRIES

($ billion)

	1987	1986	Change (%)
Nondurable goods industries[1]	1,126.6	1,060.5	6.2%
Food, kindred products	325.0	308.5	5.3
Tobacco products	19.9	19.1	4.2
Textile mill products	57.5	55.3	4.0
Paper and allied products	110.3	97.9	12.7
Chemicals and allied products	212.7	197.1	7.9
Petroleum and coal products	124.5	124.9	-0.3
Rubber and plastics products	80.5	73.4	9.7
Durable goods industries[1]	1,263.5	1,199.9	5.3
Stone, clay, and glass products	62.1	57.3	8.4
Primary metals	117.1	105.6	10.9
Fabricated metal products	135.0	138.0	-2.2
Machinery, excluding electrical	216.6	208.5	3.9
Electrical machinery	210.7	196.2	7.4
Transportation equipment	323.0	313.8	2.9
Instruments and related products	66.8	61.9	7.9
Total manufactured goods	2,390.1	2,260.4	5.7

1. Includes industries not shown.

Source: U.S. Dept. of Commerce.

Georgia-Pacific's 4.4 million tons of paper and paperboard output was third highest in 1988, followed by James River with 4.3 million tons. G-P also produced 870,000 tons of market pulp during the year.

Value of shipments. The value of industry shipments has risen steadily since 1985, when the dollar peaked and markets began to tighten. Shipments in 1985 were worth $93.41 billion—down 1.5% from 1984. Shipments bounced back to $103.83 billion in 1986—an increase of 11.2%—and they climbed to $118.86 billion in 1987 for a gain of 14.5% over 1986. Shipments climbed another 7.5% in 1988 to $127.72 billion, and through mid-1989 they were on track to reach $130.65 billion by the end of the year, according to American Paper Institute estimates. That would represent an increase of 2.3% from 1988.

For most of the decade, about 42% to 43% of the value of industry shipments has come from primary production of pulp, paper, and paperboard. The remaining 57% to 58% has come from converted paper products and paperboard boxes and containers. Reflecting higher prices for many grades, the share of primary production rose to 45% in 1988, and the split between primary and converted products is expected to be 45%/55% in 1989 as well.

Shipments of primary pulp, paper, and paperboard grades have risen steadily since 1986, when the value of shipments jumped to $46.99 billion—up 20.0% from 1985. The value of primary products shipments rose 9.6% to $51.52 billion in 1987, and it increased another 11.0% to $57.18 billion in 1988. According to API estimates, it will climb just 2.4% in 1989 to $58.56 billion.

In 1987, the latest year for which breakdowns are available, the value added by manufacturers of pulp, paper, and paperboard contributed 49% to the value of shipments vs 51% for the cost of materials. Value added by manufacturers ranged from a low of 47% for paper producers (reflecting the high cost of pulp) to 50% for paperboard producers and 53% for pulp producers.

Although still fairly fragmented, the long-term trend in the North American paper industry is toward higher concentration. In the U.S., the top ten market pulp producers held about 83% of total capacity in 1988, and 52% of overall capacity was concentrated among the top ten paper and paperboard producers.

Concentration varies considerably from grade segment to grade segment. Kraft paper is the most heavily concentrated grade, with the top five producers accounting for 69% of capacity and the top ten accounting for 93%. Coated free-sheet is also heavily concentrated. The top five producers control 66% of total U.S. capacity, and the top ten control 94%. About 75% of capacity is concentrated among the top five tissue producers, while the top ten account for 90% of total output.

The big commodity grades are less concentrated. Despite continuing consolidation in the containerboard industry, the top five kraft linerboard producers still control just 44% of the market, and the top ten control 70%. The largest five uncoated free-sheet producers account for 49% of capacity, and the top ten account for 76%.

Mergers and acquisitions are the most obvious force behind the acceleration of industry concentration in the 1980s. Companies that do not appear in the table of leading U.S. firms illustrate this fact. Nine firms dropped off the list of top companies between 1983 and 1987, all but one of them due to mergers. The exception to the rule, Jacksonville Kraft Co., went bankrupt, but was later purchased by a Stone Container-led investor group and reopened. The other eight are Container Corp. of America, Continental Forest Industries, Crown Zellerbach, Hammermill, Owens-Illinois, Publishers Paper Co., St. Regis, and Southwest Forest Industries. In 1988, Georgia-Pacific added to its market pulp capacity with the purchase of Brunswick Pulp & Paper Co., and Gaylord Container Corp. added to its containerboard capacity with the purchase of Louisiana-Pacific Corp.'s Fibreboard Div. paperboard mill assets.

The main beneficiaries of all the buyout activity—those who were most aggressive—are Stone Container, Jefferson Smurfit Corp., and James River. Other companies that added substantially to capacity through acquisitions are Champion International, International Paper, Great Northern Nekoosa Corp., Georgia-Pacific, and Federal Paper Board Co.

Also important in the long-term trend toward concentration is the growing size of mills and machines, which limits the ability of smaller operations to compete. Rising energy, fiber, and environmental-compliance costs have also hurt smaller, nonintegrated producers. The result has been a series of bankruptcies and shutdowns of older, inefficient facilities, particularly during lulls in the business cycle.

API data on the size distribution of machines in various grades show that many small machines still exist in the uncoated free-sheet, tissue, packaging papers, and recycled paperboard segments. Although many of these small machines profitably serve special market niches, some will be vulnerable to efficient, new machines being installed in the higher-volume, commodity segments of these markets.

LEADING U.S. FIRMS

(U.S. companies ranked among the top 150 worldwide in paper industry sales)

Rank	Company	1988 paper industry sales* ($ million)	% change 1988/87	% of total sales from paper ind. operations	1988 production (000 short tpy)		
					Market pulp	Paper/ board	Converted products
1	International Paper Co.	$8,197.0	17.8%	86.0%	1,077	6,501	2,296
2	James River Corp.	5,871.8	15.2	100.0	—	4,299	—
3	Kimberly-Clark Corp.	5,286.2	9.9	98.0	—	2,370	—
4	Scott Paper Co.	4,726.4	14.7	100.0	55	2,756	—
5	Champion International Corp.	3,983.7	16.2	77.7	579	3,881	—
7	Stone Container Corp.	3,641.0	22.6	97.3	261	4,479	3,351
8	Great Northern Nekoosa Corp.	3,588.1	38.6	100.0	535	3,737	—
9	Weyerhaeuser Co.	3,525.0	17.7	35.2	1,458	3,579	1,653
11	Georgia-Pacific Corp.	3,436.0	22.3	36.1	870	4,365	—
17	Boise Cascade Corp.	2,406.1	16.0	58.8	494	3,682	n.a.
22	Mead Corp.	2090.8	-1.1	46.8	399	2,095	573.196
23	Union Camp Corp.	2,052.3	14.5	77.1	—	1,750	1,264
27	Westvaco Corp.	1,948.9	12.1	91.3	110	2,375	—
37	Temple-Inland Inc.	1,429.1	13.7	80.6	134	526	2,058
38	Bowater Inc.	1,410.4	14.6	100.0	251	1,580	230
42	Sonoco Products Co.	1,325.2	18.2	75.1	—	919	—
46	Willamette Industries Inc.	1,174.7	23.4	68.5	148	1,243	1,171
52	Consolidated Papers Inc.	891.9	20.8	99.5	—	999	76
54	Potlatch Corp.	852.3	15.4	78.6	—	1,022	—
56	Federal Paper Board Co. Inc.	777.8	19.6	63.5	483	799	—
68	Chesapeake Corp.	618.9	4.1	87.0	—	856	—
70	Manville Forest Products Corp.	616.2	15.1	86.5	—	631	332
72	P.H. Glatfelter Co.	593.6	33.8	100.0	190	—	42
75	ITT Rayonier Inc.	583.0	23.3	56.3	959	—	—
76	Longview Fibre Co.	581.0	13.9	88.4	—	278	273
92	Pentair Inc.	407.3	-2.0	46.4	—	536	—
110	Pope & Talbot Inc.	291.6	32.6	56.6	176	132	132
131	Garden State Paper Co.	226.0	10.8	29.9	—	509	—

* = Sales from pulp, paper, and converting operations only.
n.a. = Not available.

Source: *Pulp & Paper International.*

U.S. CAPACITY INTEGRATED TO WOODPULP

(000 short tons)

	1987		1982		1976	
	Tons	**%**	**Tons**	**%**	**Tons**	**%**
PAPER						
Newsprint	5,493	91.5%	5,212	92.2%	3,589	89.4%
Uncoated groundwood	1,318	79.7	1,515	91.5	1,093	83.5
Coated groundwood	4,008	96.9	3,093	95.4	2,218	96.5
Coated free-sheet	2,436	75.4	1,776	78.1	1,359	71.4
Uncoated free-sheet/ cotton fiber	9,058	77.5	7,384	80.3	4,837	64.8
Thin	74	25.5	106	28.7	57	15.9
Bristols	981	90.9	946	88.5	1,092	93.7
Packaging/industrial converting	4,048	73.7	4,887	80.4	5,071	81.8
Tissue	2,266	41.2	2,606	50.8	2,043	45.4
Total	29,682	75.9	27,525	79.4	21,359	73.1
PAPERBOARD						
Unbleached kraft	19,421	100.0	17,402	100.0	14,568	100.0
Solid bleached	4,733	100.0	4,121	100.0	3,998	100.0
Semichemical	5,576	98.1	5,207	100.0	4,758	100.0
Recycled	368	4.0	346	4.0	513	5.8
Total	30,098	77.0	27,076	76.4	23,837	74.3
Total paper and board	59,780	76.5	54,601	77.9	45,196	73.7

Source: American Paper Institute.

U.S. MILL SIZE DISTRIBUTION FOR PAPER/BOARD AND WOODPULP

Mill capacity range (000 tpy)	**Paper and paperboard**				**Woodpulp**			
	Number of mills		**Annual capacity (% share)**		**Number of mills**		**Annual capacity (% share)**	
	1987	**1980**	**1987**	**1980**	**1987**	**1980**	**1987**	**1980**
0-25	137	205	2.2%	3.7%	13	30	0.3%	0.8%
26-50	89	115	4.1	6.0	16	29	1.0	2.0
51-75	69	70	5.4	6.2	16	19	1.6	2.2
76-100	38	42	4.2	5.2	12	17	1.7	2.8
101-125	27	43	3.8	6.9	13	12	2.4	2.5
126-150	26	16	4.4	3.2	8	9	1.7	2.7
151-175	8	15	1.6	3.7	10	14	2.6	4.2
176-200	21	20	4.9	5.6	9	10	2.8	3.8
201-250	31	23	8.7	7.7	20	19	7.0	7.5
251-300	20	13	7.9	5.0	15	17	6.5	8.0
301-350	12	15	5.0	6.9	9	7	4.7	4.7
351-400	8	18	3.7	9.5	14	13	8.5	8.8
401-450	16	12	8.6	7.2	10	13	6.9	9.9
451-500	11	8	6.5	5.3	14	14	10.7	12.0
Over 500	35	20	30.0	18.0	38	25	41.6	28.1
Total	548	635	100.0	100.0	217	248	100.0	100.0

Source: American Paper Institute.

United States:

PRODUCTION, EXPORTS, AND IMPORTS

After three years of strong growth and record output, paper and paperboard production flattened in 1989, along with the general economy. Through the first seven months, paper and paperboard production set a pace to reach 76.6 million tons by year's end—neck and neck with the 1988 total, according to American Paper Institute figures. Allowing for seasonal adjustments, the annual rate of paper production through July was 37.9 million tpy—about 1.1% below a year earlier. The seasonally adjusted rate for paperboard was 38.7 million tpy—0.9% ahead of 1988.

The recent trend in paper and paperboard production, although holding steady near record levels, does not show the strength that characterized the industry after business turned up in late 1985. Demand has softened, capacity has risen, and customers have taken the opportunity to work off inventories accumulated when supplies were tight and prices were increasing. This inventory reduction is one reason that paper and paperboard production lags behind the general economy, which has cooled since 1987-88 yet still grew 3.7% in first-quarter 1989 and 2.7% in the second quarter.

While inventory reductions helped flatten output in the first half of 1989, they bode well for the rest of the year. Printers, newspaper publishers, and box plants trimmed inventories to minimum levels by the end of the first half, so they will have to hit the market again for supplies during the rest of the year, especially if demand increases as many observers expected.

Through July 1989, printing/writing paper production was down 2.1% from 1988 due to drops of 5.8% in coated paper shipments and 1.7% in uncoated free-sheet. New and unfilled orders for coated papers were up sharply, however, and seasonal demand was expected to improve the outlook for uncoated free-sheet papers. Uncoated groundwood shipments continued very strong—up 9.9% through the first seven months.

A wave of new capacity announcements mars the longer-term outlook for coated papers, especially if the economy falters. Newsprint markets have already been hit hard by the prospect of overcapacity, with demand and prices declining since mid-1988. Production for the first half of 1989 was up just 0.5% from a year earlier, but the combination of a better economic outlook, lower inventories, and rock-bottom prices encouraged observers later in the year that a respite was due in the fourth quarter.

Demand remained firm for most kraft paper grades, and producers believed that the market may have bottomed out after the 10-year onslaught from plastics. Through the first half of 1989, shipments of unbleached kraft paper were down 5.1%.

Unbleached kraft linerboard production was up 1.9% in the first seven months of 1989, compared with a year earlier. Lower inventories, a seasonal pickup in demand, and the improved economic outlook were expected to bolster markets during the second half. Strong demand for solid bleached paperboard makes it an industry leader, and production through July was up 1.3% compared with 1988. Recycled paperboard fared poorly, however, with production down 2.4%.

U.S. market pulp production was up 4.9% in first-half 1989 to an annual rate of 8.8 million tons. However, rising producer inventory levels reflected a gradual easing in world pulp markets, and domestic pulp demand could be affected if customers begin to reduce inventories in anticipation of stable or declining prices.

International trade. Export demand was quite strong for most grades during 1989, despite a 9% rise in the value of the dollar during the first three quarters of the year. Total paper and paperboard exports were up 9.8% in the first half to an annual rate of 5.2 million tons. Imports of paper and paperboard declined 1.5% overall in the first half, with shipments at an annual rate of 12.3 million tons.

Unbleached kraft linerboard posted a solid gain of 4.6% during first-half 1989 for an annual rate of 2.3 million tons. The pace of woodpulp exports rose 17.3% to 6.4 million tpy. World markets appeared to weaken in September, however, as NorScan producer inventories rose above one million tons for the first time in almost two years.

Imports of uncoated free-sheet from Canada climbed 76% in the first half of 1989 as a consequence of three new machine startups. Yet, total imports of uncoated free-sheet were up only 2.1% as weak markets discouraged shipments. Coated paper imports were down 1.2% through the first half, but foreign producers were reportedly undercutting domestic price discounts, a practice encouraged by the rising dollar. Imports of woodpulp rose 0.5% through the first half.

In the slumping newsprint sector, imports of Canadian newsprint were down 6.9% in the first half of 1989, and total newsprint imports dropped 7.8%. Despite falling prices, both Canadian and U.S. producers are exporting more newsprint overseas. U.S. newsprint exports were up a whopping 83.4% through the first half. U.S. producers also increased exports of uncoated free-sheet by 9.2% and clay-coated papers by 54.4%.

HISTORICAL PRODUCTION TRENDS

Paper and paperboard production tends to follow the ups and downs of the general economy, and except for 1985, that pattern has held true during the 1980s. Following a period of relatively steady growth after the recession of 1974-75, production peaked at 61.3 million tons in 1979 before dropping off slightly in the 1980 recession year. Production recovered somewhat in 1981—rising 1.8%—but another recession began late in the year. This downward cycle turned out to be the worst in postwar history for the economy as a whole, although the 1974-75 recession was harder on paper industry production. Slumping along with the rest of the economy, paper and board production fell 4.5% in 1982 to 59.5 million tons—its lowest level since 1978.

As sharp as the 1981-82 downturn was, however, the subsequent upturn was even sharper. After falling 2.6% in 1982, real GNP rebounded by 3.6% in 1983, and then shot up 6.8% in 1984. Following the economy's lead, paper and

U.S. PAPER AND BOARD PRODUCTION BY MAJOR GRADE, 1984-88

	(000 short tons)					(Percent change)				
	1988	1987	1986	1985	1984	1988/87	1987/86	1986/85	1985/84	1984/83
PAPER										
Newsprint	5,982	5,842	5,630	5,428	5,539	2.4%	3.8%	3.7%	-2.0%	7.2%
Printing/writing	21,793	20,778	19,668	18,423	18,420	4.9	5.6	6.8	0.0	6.1
Uncoated groundwood (s)	1,624	1,498	1,540	1,521	1,565	8.4	-2.7	1.2	-2.8	2.2
Coated paper (s)	7,359	6,860	6,263	5,875	6,249	7.3	9.5	6.6	-6.0	9.3
Uncoated free-sheet (s)	11,277	10,966	10,410	9,690	9,152	2.8	5.3	7.4	5.9	4.9
Thin paper	217	240	271	262	303	-9.6	-11.4	3.4	-13.5	3.8
Cotton fiber (s)	167	163	152	144	147	2.5	7.2	5.6	-2.0	10.5
Bleached bristol (s)	1,150	1,052	1,033	970	1,003	9.3	1.8	6.5	-3.3	3.7
Tissue paper	5,476	5,301	5,095	4,941	4,941	3.3	4.0	3.1	0.0	3.2
Packaging and industrial converting (s)	5,199	5,074	5,117	5,204	5,586	2.5	-0.8	-1.7	-6.8	1.7
Unbleached kraft paper (s)	3,038	3,081	3,303	3,403	3,684	-1.4	-6.7	-2.9	-7.6	0.5
Other paper	2,162	1,993	1,814	1,801	1,902	8.5	9.9	0.7	-5.3	4.0
Total paper	38,450	36,995	35,510	34,036	34,466	3.9	4.2	4.3	-1.2	5.0
PAPERBOARD										
Unbleached kraft linerboard	17,897	17,683	16,402	15,183	16,037	1.2	7.8	8.0	-5.3	6.9
Other unbleached kraft board	1,244	1,215	1,287	1,184	1,149	2.4	-5.6	8.7	3.0	2.5
Semichemical paperboard	5,666	5,540	5,376	5,088	5,169	2.3	3.1	5.7	-1.6	9.3
Solid bleached	4,511	4,406	4,222	3,948	4,048	2.4	4.4	6.9	-2.5	3.1
Recycled	8,789	8,601	8,092	7,630	7,637	2.2	6.3	6.1	-0.1	3.2
Total paperboard	38,107	37,445	35,379	33,034	34,039	1.8	5.8	7.1	-3.0	5.8
Total paper and paperboard	76,557	74,440	70,889	67,070	68,505	2.8	5.0	5.7	-2.1	5.4
CONSTRUCTION & WET MACHINE	n.a.	1,600	1,600	1,700	1,800	—	—	-5.9	-5.6	—
Total paper and paperboard	n.a.	76,040	72,489	68,770	70,305	—	4.9	5.4	-2.2	5.2

(s) = Shipments.
n.a. = Not available.
Note: Data may not add to totals because of rounding.
Source: American Paper Institute

paperboard production jumped to a record 65.0 million tons in 1983. This figure was 9.3% higher than depressed year-earlier levels, and it was up 4.4% from the previous high of 62.3 million tons produced in 1981. Production climbed an additional 5.8% in 1984 and reached a new high of 68.8 million tons, despite some weakening during the final quarter of the year.

Slower growth and the strong dollar choked off the industry's recovery in 1985, as production fell 2.0% to 67.0 million tons. A sluggish economy depressed domestic demand for such important grades as kraft linerboard, where production plummeted 5.3%. The strong dollar did double damage by making offshore paper cheap for U.S. consumers and by making U.S. exports expensive in overseas markets.

After a "Group of Five" meeting in the third quarter of 1985, the dollar began its long drop against many world currencies, a trend that continued through 1987. Domestic demand also began to pick up during this period, and the result was a dramatic rebound for paper and paperboard production in 1986 to a record 70.9 million tons—up 5.6% from the previous year.

Consumer spending was a big factor in the 1986 upswing. Corrugated box shipments increased by 6% and folding cartons by 4%, reflecting strong gains in market segments such as appliance and television production. Printing/writing paper shipments posted a 6.5% gain, fueled by increased demand for office papers as well as higher printing activity.

The weaker dollar and continued moderate growth in the economy produced a banner year for the industry in 1987. Paper and paperboard production set another record, rising 5.0% to 74.5 million tons. Paperboard production achieved an all-time high, led by a 7.4% increase in unbleached kraft linerboard production. New production records were also set in solid bleached board and recycled board.

Demand for white papers grew as offices increased their use of copy paper, computer printout, and envelopes, and strength in direct mail boosted printing paper demand. Coated paper shipments climbed 9.7% for the year, while

U.S. WOODPULP PRODUCTION BY MAJOR GRADES, 1982-88

(000 short tons)

	1988	1987	1986	1985	1984	1983	1982
WOODPULP							
Bleached sulfite	1,365	1,269	1,275	1,364	1,359	1,306	1,242
Unbleached sulfite	195	171	164	196	259	310	345
Total sulfite	1,560	1,440	1,439	1,560	1,618	1,616	1,587
Bleached and semibleached sulfate	26,302	25,411	24,158	22,626	22,350	21,107	19,721
Unbleached sulfate	21,681	21,442	20,481	19,510	20,721	19,590	18,170
Total white pulp (bleached sulfite + bleached and semibleached sulfate)	27,667	26,680	25,433	23,990	23,709	22,413	20,963
Total chemical paper-grade (total sulfite + bleached and semibleached sulfate + unbleached sulfate	49,543	48,293	46,078	43,696	44,689	42,313	39,478
Semichemical	4,357	4,246	4,191	4,026	4,069	3,812	3,700
Mechanical	5,943	5,702	5,476	5,251	5,506	5,067	5,064
Total paper-grade	59,843	58,241	55,745	52,973	54,264	51,192	48,242
Dissolving, special alpha	1,367	1,312	1,257	1,174	1,206	1,261	1,092
Total woodpulp	61,210	59,553	57,002	54,147	55,470	52,453	49,334
MARKET PULP							
Chemical paper-grade	7,200	6,806	6,316	5,613	5,680	5,255	4,643
Groundwood, other	0	0	5	15	15	12	1
Dissolving	1,365	1,308	1,251	1,172	1,204	1,260	1,089
Total market pulp	8,565	8,114	7,572	6,800	6,899	6,527	5,733
OPERATING RATES (%)							
Total white pulp	100.9	99.1	97.5	95.6	99.6	98.8	94.7
Total paper-grade	97.7	97.7	95.5	88.9	92.0	88.9	83.7
Dissolving/special alpha	97.6	94.5	89.8	80.7	81.1	82.7	68.0

Source: American Paper Institute.

uncoated free-sheet posted a 5.5% increase. Newsprint production rose 3.8% to a record 5.8 million tons, as U.S. consumers increased consumption for the fifth year in a row.

In 1988, paper and paperboard producers achieved record highs for the third consecutive year. Production rose 2.8% to 76.6 million tons, and market pulp output climbed 4.4% to 8.5 million tons. Fears of an economic slowdown or downturn in the months following the October 1987 stock-market crash never panned out. Far from slowing down, the economy grew at a strong 4.4% clip in 1988, as measured by real GNP. Moderate capacity expansion during the year helped keep operating rates high.

OPERATING RATES FOR MAJOR GRADE SEGMENTS

(production or shipments/annual capacity)

	1988	1987	1986	1985	1984
PAPER					
Newsprint	97.8%	97.3%	97.0%	93.8%	94.7%
Printing/writing (s)	94.5	94.1	93.5	90.0	92.5
Tissue	97.3	96.3	93.1	92.4	93.3
Packaging/industrial converting (s)	96.4	92.4	88.9	87.0	91.2
Total paper	95.6	94.7	93.3	90.5	92.7
PAPERBOARD					
Unbleached kraft	94.9	97.3	94.8	90.2	96.4
Semichemical	97.8	97.5	96.7	94.0	98.4
Solid bleached	96.4	93.1	93.3	90.3	96.7
Recycled	92.8	92.8	89.7	86.8	87.6
Total paperboard	95.0	95.8	93.8	90.0	94.6
TOTAL PAPER/PAPERBOARD	95.3	95.2	93.5	90.2	93.6

(s) = Shipments.

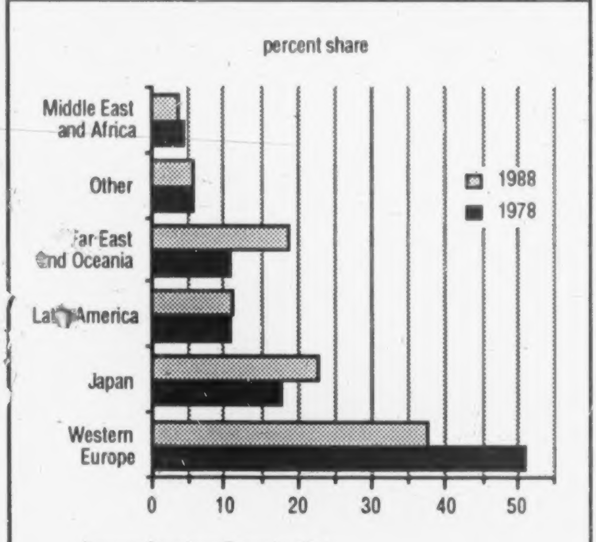
Source: American Paper Institute.

Paper grades fared the best, led by 4.9% growth in the printing/writing sector. Strongest demand for uncoated free-sheet—where production was up 2.8% overall—came from book publishers. A 7.3% hike in coated paper output was fueled by magazine publishers and commercial printers.

Paperboard production grew a relatively modest 1.8% in 1988, led by a 2.4% increase in solid bleached grades. After two years of strong growth, unbleached kraft linerboard production posted a modest gain of 1.2% in 1988, as exports dropped 2.6%. Production of containerboard for the domestic market climbed 2.2%, and U.S. fiber box shipments rose 3.2% for the year.

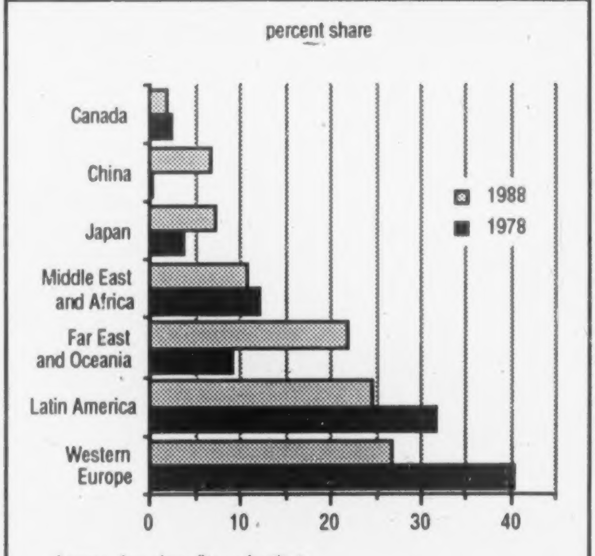
When faced with competitive world markets, U.S. exports tend to fluctuate with ex-

WOODPULP EXPORTS BY DESTINATION



Source: American Paper Institute.

KRAFT LINERBOARD EXPORTS BY DESTINATION



Source: American Paper Institute.

change rates. In 1980, after a multi-year slide, the dollar reached its weakest point relative to other major currencies, and U.S. paper industry exports (including pulp, wastepaper, and converted products) posted a 31.9% increase in volume to a record 11.8 million tons. In 1981, the dollar strengthened, and recession began to affect major overseas markets, causing industry exports to fall 9.9%, although the value of shipments rose a modest 1.4%. In the 1982 recession year, exports fell an additional 7.4%, while the value of shipments plummeted 11.9% due to lower prices and the ever-stronger dollar.

With both prices and demand up in 1983, exports rose 10.3% over year-earlier levels, but the value of shipments actually declined by 2.2% because of the strong dollar.

In 1984, the dollar set records against major currencies, undercutting U.S. exports in the important market pulp and linerboard sectors despite strong demand in overseas markets. Overall industry exports rose 14.7% to 12.3 million tons, however, on the strength of a 70.4% increase in wastepaper. The value of shipments for paper, board, and converted products rose 7.2%. Paperboard exports declined 6.7% in 1984, following a 13.4% increase in 1983, while pulp exports were off 1.4%. In 1985, both the strong dollar and weakness in world markets sent exports down 3.4% for

HISTORICAL U.S. PAPER AND BOARD PRODUCTION, CAPACITY, AND OPERATING RATES, 1960-88

(000 short tons)

	Production				Capacity		Operating rate
Year	Paper	Paperboard	Total paper/ board[1]	Change (%)	Total paper/ board[1]	Change (%)	Total paper/ board
1988	38,450	38,107	76,557	2.8%	80,315	2.7%	95.3%
1987	36,995	37,445	74,440	5.0	78,186	3.2	95.2
1986	35,510	35,379	70,889	5.9	75,777	2.0	93.5
1985	34,036	32,922	66,958	-2.2	74,301	1.6	90.1
1984	34,466	34,002	68,468	5.4	73,098	2.8	93.7
1983	32,816	32,145	64,961	9.6	71,126	1.5	91.3
1982	30,252	29,044	59,296	-4.5	70,086	2.8	84.6
1981	30,901	31,208	62,109	1.7	68,172	2.7	91.1
1980	30,116	30,926	61,042	0.0	66,368	2.7	92.0
1979	29,666	31,404	61,070	4.3	64,615	2.4	94.5
1978	28,320	30,252	58,572	3.4	63,091	1.8	92.8
1977	27,721	28,935	56,656	3.0	62,004	1.1	91.4
1976	26,577	28,415	54,992	14.6	61,307	1.9	89.7
1975	23,260	24,737	47,997	-13.9	60,140	1.0	79.8
1974	26,863	28,894	55,757	-1.0	59,527	2.3	93.7
1973	26,797	29,550	56,347	4.7	58,164	4.1	96.9
1972	25,359	28,484	53,843	8.2	55,873	3.2	96.4
1971	23,722	26,019	49,741	2.1	54,136	1.6	91.9
1970	23,351	25,367	48,718	-2.2	53,260	0.3	91.5
1969	23,449	26,362	49,811	5.8	53,094	3.8	93.8
1968	22,181	24,890	47,071	7.6	51,147	4.7	92.0
1967	20,926	22,819	43,745	-0.4	48,850	4.8	89.5
1966	20,725	23,179	43,904	8.4	46,608	7.1	94.2
1965	19,157	21,332	40,489	6.4	43,535	4.6	93.0
1964	18,112	19,954	38,066	6.0	41,623	3.7	91.5
1963	17,320	18,594	35,914	4.4	40,143	3.4	89.5
1962	16,560	17,847	34,407	5.7	38,810	1.3	88.7
1961	15,821	16,727	32,548	4.3	38,299	4.0	85.0
1960	15,295	15,926	31,221	15.4	36,840	3.1	84.7
Average annual change	1980-88			2.6%		2.4%	
	1970-79			2.3		2.0	
	1960-69			6.4		4.0	

1. Excludes hardpressed board, construction paper and board, and wet machine board.

Source: American Paper Institute.

the year, while the value of shipments plummeted 10.7%.

After peaking against major world currencies in 1985, the dollar dropped steadily through 1986 and 1987 to about half of its 1985 value. This ongoing slide in the U.S. dollar reversed the competitive position of U.S. suppliers and caused a tremendous improvement in U.S. exports.

In 1986, U.S. producers were well positioned to take advantage of renewed demand overseas. Overall industry exports rose to 12.9 million tons for the year—a 9.1% gain over 1985—while the value of shipments climbed 16.2%. Paperboard exports, mainly consisting of kraft linerboard, rose 21.8% for the year. Pulp shipments rose 17.5%, while wastepaper declined 7.9%.

U.S. exporters continued to benefit from the weak dollar in 1987, as overall exports rose another 12.1% to 14.5 million tons. Due to record prices, the value of shipments posted a big 27.8% gain over 1986. Of the important export segments, wastepaper was strongest, rising 18.0%. Pulp exports were up 9.7% compared with 1986, followed by a 6.7% increase in paperboard exports.

In 1988, exports of paper and paperboard reached a new high of 4.7 million tons, up 6.1% from the previous year. Shipments were valued at $2.6 billion, a gain of 18.4% over 1987. The increase came despite a change in direction for the dollar, which began to rise against foreign currencies in the second quarter. Woodpulp exports rose to a record 5.5 million tons, up 13.1% from 1987, while higher prices pushed the value of shipments up 29.0% to $2.9 billion.

Paper exports of 1.1 million tons were up 19.7% from 1987 levels, accompanied by a 27.0% rise in the value of shipments to $987 million. Shipments of 427,000 tons made newsprint the most important export grade, and its increase of 25.6% over 1987 shipments was the largest among the paper grades.

Because of lower shipments of containerboard and recycled board, paperboard exports in 1988 posted an increase of only 2.5% to 3.6 million tons. The value of shipments held up better with a 13.8% increase overall. Kraft linerboard exports dipped 0.7% to 2.3 million tons, largely due to a 44% drop in shipments to People's Rep. China. Despite the small decline in tonnage, the value of kraft linerboard exports rose

HISTORICAL U.S. WOODPULP PRODUCTION, CAPACITY, AND OPERATING RATES

(000 short tons)

Year	Production* Total*	Captive	Market	Total* capacity	Operating rate (%)
1988	61,161	52,596	8,565	62,672	97.6%
1987	59,552	51,438	8,114	61,166	97.4
1986	57,002	49,429	7,573	59,743	95.4
1985	54,147	47,347	6,800	58,612	92.4
1984	55,471	48,572	6,899	57,713	96.1
1983	52,454	45,928	6,526	56,112	93.5
1982	49,334	43,602	5,732	56,091	88.0
1981	52,042	45,839	6,203	54,833	94.9
1980	50,734	44,269	6,465	53,154	95.4
1979	49,366	44,688	4,678	51,574	95.7
1978	46,888	41,726	5,162	49,723	94.3
1977	46,648	41,828	4,820	49,839	93.6
1976	45,385	40,515	4,870	48,681	93.2
1975	40,584	36,240	4,344	46,575	87.1

* Includes paper-grade, dissolving/special alpha pulps, but excludes defibrated/exploded pulps, screenings, and fiber other than wood.

Source: American Paper Institute.

TOP PRODUCING STATES IN 1987

(000 short tons)

Pulp		Paper		Paperboard	
Georgia	6,887	Wisconsin	4,266	Georgia	4,802
Alabama	6,397	Maine	3,252	Alabama	3,125
Louisiana	4,970	Washington	2,678	Louisiana	2,980
Washington	4,531	Alabama	2,541	Florida	2,096
Florida	3,710	Louisiana	1,935	Oregon	1,983
Texas	3,123	Pennsylvania	1,835	Virginia	1,858
North Carolina	3,112	New York	1,688	South Carolina	1,847
Oregon	3,070	Oregon	1,568	California	1,389
South Carolina	2,949	Michigan	1,555	Michigan	1,381
Virginia	2,897	Georgia	1,505	Tennessee	1,280

Note: Production figures for several top-producing states are excluded by the Dept. of Commerce to avoid revealing data for individual companies, biasing the above list against states with a small number of major producers. Such states include Texas, Mississippi, and South Carolina.

Source: Bureau of the Census.

9.3%. Strong overseas markets for milk carton stock helped fuel a 14.7% increase in bleached paperboard exports to 743,000 tons.

IMPORTS CAPTURE BIGGER MARKET SHARE

Imports have not responded to exchange-rate fluctuations in the same way as exports. Imports rose dramatically as the dollar strengthened during the 1983-85 period, and they continued to rise as the dollar weakened after 1985. The size of the U.S. trade relationship with Canada is one reason for imports' seeming lack of response to exchange-rate fluctuations, because the Canadian dollar has been even weaker than the U.S. dollar. Another factor is the size and attractiveness of the U.S. market. European suppliers who gained a foothold in the U.S. while exchange rates were favorable have been slow to give up their shipments since the dollar turned against them.

Canada will account for about 85% of foreign shipments to the U.S. in 1989, with pulp and newsprint being the dominant grades. Imports from Canada will climb about 3% over 1988 levels. Canada is the major source of U.S. newsprint supplies, although its share has dropped over the long term from 80% in 1950 to 63% in 1970 to about 59% in 1989. Canada is also the largest foreign supplier of U.S. woodpulp, with a 7% share of the U.S. market. Canada and the U.S., the two largest trading partners in the world, have agreed on a bi-national trade agreement that will eliminate tariffs for numerous paper and paperboard grades by 1993. Tariffs on these designated products will be cut in five, equal annual stages.

While depressing U.S. exports, the strong dollar, coupled with a booming economic expansion, encouraged a flood of imports into the U.S. in 1983 and 1984. Overall imports of paper, board, pulp, and converted products rose 12.1% in 1983 to 12.7 million tons. The flood continued in 1984, as total industry imports rose another 19.5% to 15.2 million tons. Printing/writing paper imports, attracted to the U.S. by the strong dollar, grew 51% in 1983 and another 78% in 1984, jumping from just 764,000 tons in 1982 to over 2 million tons in 1984.

Newsprint and market pulp import markets, though dominated by Canada, were also strong enough during this period to attract attention from offshore. Canadian shipments of newsprint to the U.S. grew 9.1% in 1984, while overall U.S. newsprint imports climbed 14.1%. Woodpulp imports from all sources grew 9.7% in 1984, while shipments from Canada posted an 8.0% increase.

In the poorer market conditions of 1985, offshore pro-

INVENTORY LEVELS FOR PULP, NEWSPRINT, AND CONTAINERBOARD

Year	Norscan producer pulp stocks[1] (000 metric tons)	U.S. consumer newsprint stocks[2] (000 metric tons)	(days)	U.S. containerboard inventories[3] (000 short tons)	(weeks)
1988					
Dec.	666	1,469	46	2,487	5.3
Sept.	767	1,626	44	2,732	6.2
June	670	1,544	49	2,595	5.9
Mar.	805	1,512	44	2,589	5.8
1987					
Dec.	691	1,411	45	2,396	5.3
Sept.	856	1,509	41	2,437	5.5
June	795	1,405	44	2,383	5.6
Mar.	867	1,367	40	2,391	5.4
1986					
Dec.	870	1,268	42	2,134	5.3
Sept.	920	1,451	41	2,344	5.8
June	960	1,369	44	2,394	6.1
Mar.	1,133	1,405	42	2,489	6.1
Year-end					
1985	1,329	1,394	46	2,469	6.6
1984	1,619	1,329	45	2,442	7.1
1983	1,207	1,179	42	2,415	6.5
1982	1,603	1,258	47	2,524	7.6
1981	1,430	1,477	56	2,729	9.4
1980	949	1,090	42	1,984	6.2
1979	616	877	34	1,979	6.2
1978	903	971	38	1,961	5.8
1977	2,083	1,071	43	2,437	7.2
1976	2,825	1,209	52	2,527	8.1
1975	2,011	911	44	2,185	7.2
1974	611	1,061	48	2,323	8.2
1973	629	757	32	1,595	4.7
1972	1,149	667	26	1,603	5.1
1971	1,618	885	38	1,639	5.7
1970	647	944	42	1,879	7.0
Year-end averages					
1980-88	1,152	1,319	46	2,398	6.6
1970-79	1,309	935	40	2,013	6.5

1. Chemical paper-grade market pulp stocks at North American/Scandinavian producer mills (source: American Paper Institute).
2. Estimated U.S. publisher stocks of newsprint and days of supply (source: Canadian Pulp & Paper Assn.).
3. Containerboard inventories at box plants and mills and weeks of supply (source: Fibre Box Assn.).

ducers were cushioned to some extent by the strong U.S. dollar. Domestic coated paper producers, for example, enjoyed strong demand in 1985, but were unable to raise prices because of a surge of European imports. Overall imports rose 3.2%, thanks to a 5.2% increase in paper imports. Printing/writing papers declined 6.4%, but they were still very high by historical standards.

As the dollar weakened in late 1985, giving a boost to U.S. exports, the import situation remained relatively stable. Overall imports climbed another 4.0% in 1986, with printing/writing papers posting a 6.1% increase. Pulp import growth was a moderate 2.6% overall, but Canadian shipments climbed 3.1%.

In 1987, total industry imports climbed a strong 7.5%, even as the dollar continued to weaken. Despite the dollar's slide, many European exporters of printing/writing papers maintained their U.S. shipments because of strong demand from commercial printers. Canadian shipments to the U.S. accounted for half of printing/writing imports, as Canadian producers continued to benefit from the even weaker Canadian currency. Strong demand and tight markets resulted in an 18.8% increase in printing/writing imports. Canadian newsprint shipments to the U.S. jumped 5.2%.

In 1988, continued strong domestic demand caused a 16.7% jump in printing/writing papers imports to 2.8 million tons. The increase was offset, however, by a 2.1% de-

U.S. PAPER INDUSTRY EXPORTS, IMPORTS, AND NET TRADE BALANCE

	1988		1987		1986		1979	
	Tons (000)	Value ($ million)	Tons (000)	Value ($ million)	Tons (000)	Value ($ million)	Tons (000)	Value ($ million)
EXPORTS								
Woodpulp	5,528	$2,915	4,889	$2,259	4,458	$1,662	2,935	$1,104
Paper	1,102	987	921	777	884	642	601	507
Newsprint	427	295	340	210	392	195	71	32
Printing/writing	287	313	249	243	191	185	275	233
Packaging and industrial	347	342	294	293	284	241	227	218
Tissue	41	37	38	31	17	21	28	24
Paperboard	3,641	1,645	3,551	1,445	3,322	1,166	2,447	791
Kraft linerboard	2,281	888	2,297	812	2,196	642	1,645	435
Other unbleached kraft paperboard	292	103	211	79	158	58	100	34
Semichemical medium	42	18	64	23	77	22	17	5
Bleached packaging paperboard	743	503	648	408	571	360	509	239
Recycled paperboard	283	133	331	123	320	84	176	78
Total paper/paperboard	4,743	2,632	4,472	2,222	4,206	1,808	3,048	1,298
Converted products	815	1,051	725	823	526	686	562	586
Construction and wet machine	132	69	107	59	94	52	62	31
Wastepaper	5,640	688	4,422	553	3,749	411	2,233	256
Cotton pulp and other fiber	202	112	182	91	157	73	131	75
Total industry exports	17,060	7,467	14,797	6,007	13,190	4,692	8,971	3,350
IMPORTS								
Woodpulp	5,038	2,663	4,850	2,069	4,582	1,601	4,318	1,465
Paper	12,017	6,750	11,765	5,768	10,926	5,052	8,560	2,896
Newsprint	8,802	4,570	8,987	4,121	8,588	3,682	7,223	2,300
Printing/writing	2,812	1,900	2,410	1,412	2,029	1,180	1,179	512
Packaging and industrial	343	232	310	192	243	146	141	74
Tissue	60	48	58	43	66	44	17	10
Total paperboard	341	131	361	127	281	88	82	19
Total paper/paperboard	12,358	6,881	12,126	5,895	11,207	5,140	8,642	2,915
Converted products	430	1,013	402	933	390	789	96	223
Construction and wet machine	322	108	309	99	340	107	385	70
Wastepaper	161	27	127	19	99	11	78	11
Total industry imports	18,309	10,692	17,814	9,015	16,618	7,648	13,519	4,684
NET TRADE BALANCE (deficit)								
Woodpulp	490	252	39	190	(124)	61	(1,383)	(361)
Paper/paperboard	(7,615)	(4,249)	(7,654)	(3,673)	(7,001)	(3,332)	(5,594)	(1,617)
Total industry	(1,249)	(3,226)	(3,017)	(3,008)	(3,428)	(2,956)	(4,548)	(1,334)

Sources: American Paper Institute, Dept. of Commerce.

cline in newsprint imports to 8.8 million tons. Canada and Finland were the largest suppliers of printing/writing papers, which consisted mostly of uncoated groundwood and clay-coated papers. Overall imports of paper and paperboard totaled 12.4 million tons—up 1.9% from 1987. Shipments in 1988 were valued at $6.9 billion—up 16.7% from the previous year. Woodpulp imports climbed 3.9% to 5.0 million tons, with the value of those shipments totaling $2.7 billion—up 28.7%.

The dollar remained low enough in 1988 to discourage imports from Europe, despite strengthening during the course of the year, and booming European markets made the U.S. market less attractive as well. Canadian producers sought other markets because of the increase in value of the Canadian dollar. Because Canadian imports are priced in U.S. dollars, Canadian producers are hurt by weakness in the U.S. currency relative to their own. Canada remains the largest U.S. supplier by a wide margin, however, supplying 86% of pulp imports, 96% of newsprint, and 71% of uncoated groundwood papers.

HISTORICAL U.S. PAPER AND PAPERBOARD PRODUCTION, IMPORTS, EXPORTS, AND APPARENT CONSUMPTION, 1950-88

Year	Production[1] (000 tons)	Imports[1] (000 tons)	Exports[1] (000 tons)	Apparent consumption[2] (000 tons)	Real GNP (billion 1982 $)	Ratio consumption to real GNP (000 tons/ billion $)	Population (million)	Per capita consumption (lb/capita)
1988	76,557	12,358	4,745	84,170	$3,996.0	21.06	245.5	685.7
1987	74,440	12,528	5,197	81,771	3,847.0	21.26	243.9	670.5
1986	70,889	11,597	4,593	77,893	3,721.7	20.93	241.6	644.8
1985	66,958	11,105	4,003	74,060	3,618.7	20.47	239.3	619.0
1984	68,468	10,576	4,310	74,734	3,501.4	21.34	237.0	630.7
1983	64,961	8,509	4,502	68,968	3,279.1	21.03	234.8	587.5
1982	59,296	7,603	4,187	62,712	3,166.0	19.81	232.5	539.5
1981	62,109	7,941	4,561	65,489	3,248.7	20.16	230.1	569.2
1980	61,042	8,304	5,148	64,198	3,187.2	20.14	227.8	563.6
1979	61,071	8,738	3,610	66,199	3,192.4	20.74	225.1	588.2
1978	58,571	8,781	3,301	64,051	3,115.2	20.56	222.6	575.5
1977	56,656	7,294	3,171	60,779	2,958.6	20.54	220.2	552.0
1976	54,993	7,042	3,388	58,647	2,826.7	20.75	218.0	538.0
1975	47,997	6,164	3,050	51,111	2,695.0	18.97	216.0	473.3
1974	55,756	7,970	3,720	60,006	2,729.3	21.99	213.9	561.1
1973	56,346	8,019	2,965	61,400	2,744.0	22.38	211.9	579.5
1972	53,842	7,567	3,019	58,390	2,608.5	22.38	209.9	556.4
1971	49,742	7,319	3,076	53,985	2,484.8	21.73	207.7	519.8
1970	48,719	7,057	2,780	52,996	2,416.2	21.93	205.1	516.8
1969	49,810	7,210	2,702	54,318	2,423.3	22.41	202.7	535.9
1968	47,071	6,792	2,587	51,276	2,365.6	21.68	200.7	511.0
1967	43,745	6,916	2,053	48,608	2,271.3	21.40	198.7	489.3
1966	43,904	7,327	1,903	49,328	2,208.3	22.34	196.6	501.8
1965	40,489	6,549	1,736	45,302	2,087.6	21.70	194.3	466.3
1964	38,066	6,154	1,661	42,559	1,973.3	21.57	191.9	443.6
1963	35,914	5,637	1,302	40,249	1,873.3	21.49	189.2	425.5
1962	34,407	5,719	1,154	38,972	1,799.4	21.66	186.5	417.9
1961	32,548	5,663	1,175	37,036	1,708.7	21.67	183.7	403.2
1960	31,221	5,610	990	35,841	1,665.2	21.52	180.7	396.7
1955	26,772	5,313	805	31,280	1,485.2	21.06	165.9	377.1
1950	21,563	4,973	337	26,199	1,210.3	21.65	152.3	344.0

1. Excludes wet machine board, construction paper and board, and hard pressed board.
2. Apparent consumption (new supply) = production + imports — exports.

Sources: American Paper Institute, Dept. of Commerce.

ANTICIPATED SCHEDULE OF TARIFF REDUCTIONS FOR SELECTED GRADES, 1988-93

	1993	1992	1991	1990	1989	1988
Canadian tariffs on imports from U.S.						
Printing papers						
cut to size	0.0%	1.6%	3.2%	4.8%	6.4%	8.0%
not cut to size	0.0	1.3	2.6	3.9	5.2	6.5
Writing papers	0.0	1.3	2.6	3.9	5.2	6.5
Coated groundwood	0.0	0.5	1.0	1.5	2.0	2.5
Recycled boxboard	0.0	1.8	3.6	5.4	7.2	9.2
Linerboard	0.0	1.3	2.6	3.9	5.2	6.5
Solid bleached board	0.0	1.3	2.6	3.9	5.2	6.5
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Unbleached kraft paper	0.0	0.8	1.6	2.4	3.2	4.0
Bleached wrapping papers	0.0	1.8	3.6	5.4	7.2	9.2
Sanitary papers (rolls)	0.0	1.3	2.6	3.9	5.2	6.5
cut to size	0.0	2.0	4.0	6.0	8.0	10.2
Folding cartons	0.0	2.0	4.0	6.0	8.0	10.2
Corrugated boxes	0.0	1.8	3.6	5.4	7.2	9.2
Paper bags	0.0	1.8	3.6	5.4	7.2	9.2
U.S. tariffs on imports from Canada						
Bristols, drawing	0.0%	0.4%	0.7%	1.0%	1.3%	1.6%
Carbonizing paper						
15 g/m^2 and under	0.0	0.5	1.0	1.5	2.0	2.6
over 15 g/m^2	0.0	0.4	0.8	1.2	1.6	2.0
Cover, writing	0.0	0.4	0.9	1.4	1.9	2.4
India, bible papers						
less than 40 g/m^2	0.0	0.4	0.7	1.0	1.3	1.6
40 to 150 g/m^2	0.0	0.2	0.6	1.0	1.4	1.8
Coated printing papers						
woodfree	0.0	0.5	1.0	1.5	2.0	2.5
groundwood, LWC	0.0	0.5	1.0	1.5	2.0	2.5
Sulfite wrapping	0.0	0.4	0.9	1.4	1.9	2.4
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Packaged sanitary	0.0	1.3	2.3	3.3	4.3	5.3

Source: Canadian Pulp & Paper Assn.

United States:

PRICES

Prices for paper, paperboard, and converted products tend to weaken or decline in recessions and to rise strongly in economic recoveries. Fiber prices are even more volatile, with wastepaper tending to lead economic cycles and woodpulp to lag them.

Pulp and paper prices rose sluggishly during the first half of the 1980s because of back-to-back recessions early in the decade and because of the U.S. dollar's strength in 1984 and 1985. The strong dollar attracted more imports of paper into U.S. markets and made it increasingly difficult for U.S. and Canadian mills to export market pulp and paperboard. The dollar's impact on pulp, paper, and board prices was as severe as any recession. In 1985, prices for paper rose only 0.2% from the previous year, according to the Dept. of Commerce's Bureau of Labor Statistics (BLS). Paperboard prices declined 4.8%, and woodpulp prices plunged 12.6%.

The subsequent slide in the dollar's value between 1986 and 1989 has had exactly the opposite effect. The woodpulp price index shot up 20.0% between January 1986 and January 1987, followed by a further 14.3% boost between January 1987 and January 1988. Over the two-year period, paperboard prices jumped by more than 17%; while paper prices rose 12%.

New records were posted for several grades in 1987, and these were exceeded again in 1988 as demand strengthened and the dollar drifted downward. In 1987, the woodpulp index rose 17.7%, wastepaper climbed 27.7%, paperboard prices rose 10.8%, and paper grades posted a 4.2% increase. In 1988, the woodpulp index jumped 22.6%, while wastepaper inched up another 1.2%. Paperboard prices for the year were up 12.8%, and paper grades posted a 10.5% advance.

Pulp, paper, and converted products have been slightly more resistant to the deflationary pressures of the 1980s than the overall producer price index. Prices have risen 5.1%/year on average for pulp, paper, and converted products vs 4.0%/year for all industrial commodities. Over the long term, however, paper industry prices have kept closer pace with the overall index, rising an average of 6.7%/year since 1970 vs 6.5%/year for industrial commodities.

PULP'S UPTURN LEVELING OFF

Pulp prices are highly cyclical and tend to lag fluctuations in the world economy by as much as two years. One reason is that integrated producers are usually net buyers of pulp during strong markets but net sellers during times of weakness, causing sharp swings in supply and demand. Other factors include producer inventory levels, operating rates, and changes in average manufacturing costs. Historically, pulp prices have risen when the ratio of shipments to capacity reaches 87% to 88% and when North American and Scandinavian producer inventories have dropped to about 1.2 million metric tons. Exchange-rate fluctuations have also had an impact on pulp prices; which are quoted mainly in U.S. dollars.

Pulp prices did not fare well for most of the 1980s. The BLS index for woodpulp climbed just 4.5%/year during the 1980-87 period, far below the 14.0% annual growth of the 1970s. The picture improved with significant jumps of 17.7% and 22.6% in 1987 and 1988, respectively, which brought the average annual rate for the 1980s to 6.5%.

Following a decade of stability during the 1960s, pulp pricing changed drastically in the 1970s as a result of growing market tightness and a sharp escalation in production costs—particularly for energy and wood—in the 1973-74 and 1978-80 periods. In the 1978 downturn, the list price for benchmark northern bleached softwood kraft (NBSK) reached a low of $330/metric ton (delivered in U.S.). It then rose for eight consecutive quarters, hitting $530/ton in 1980. This represented a 61% rise from the 1978 trough.

Subsequent attempts to raise prices proved unsuccessful, however. The official $545/metric ton (c.i.f., northern Europe) list price that had been in effect for two years broke in the second quarter of 1982 and plummeted to $400 to

$410/ton by first-quarter 1983. This 26% decline was even worse than the 1977-78 drop. Exchange rates played a major role in the decline, as the strong dollar undermined pulp prices by giving Scandinavian and nontraditional producers a cost advantage, allowing them to cut prices to add market share. At the same time, the strong dollar made pulp more expensive for buyers with weak currencies, who became more resistant to increases. While the U.S. dollar price dropped 26% from 1980 to 1982, the price of pulp in pounds sterling, liras, and francs actually rose about 8%, and the deutsche mark price declined by 11%.

Pulp prices firmed only slightly in 1983, but a labor dispute in British Columbia sparked a recovery to $540/metric ton for NBSK in Europe during the first half of 1984. However, overproduction later in the year coupled with a large bulge of new capacity drove the price back down to a low of about $390/ton by early 1985.

Chemical paper-grade pulp prices climbed four consecutive quarters in 1986 as the U.S. dollar weakened and as demand strengthened. The declining dollar reversed the cost advantage of Scandinavian producers and made price increases easy to swallow for overseas customers. NBSK prices rose to $520/metric ton during the last quarter of 1986—a 33% increase for U.S. customers, but only 3% in Japan and 4% in Fed. Rep. Germany.

Producers followed up with price hikes in each quarter of 1987 and 1988 and in the first two quarters of 1989. These brought the price of NBSK in Europe to $840/metric ton by second-quarter 1989. Consequently, market pulp prices rose to roughly twice what they were in 1980, but a strengthening U.S. dollar and projected capacity expansions are expected to keep prices stable through 1989, perhaps sending them downward in 1990.

PAPER RESPONDS TO ECONOMIC LULL

Paper weathered the last recession better than other industry products, but prices have suffered in recent years from overcapacity in key printing/writing grades. The BLS price index for paper grades rose an average of 5.0%/year during the 1980-88 period, compared with 8.6% annual growth in the 1970s.

Newsprint. In October 1982, newsprint prices fell for the first time since the Great Depression, dropping from the $500/metric ton list price established in the U.S. East market in mid-1981 to $468/ton. Overcapacity forced the drop-

PRICE INDEXES FOR U.S. PULP, PAPER, AND PRODUCTS vs ALL INDUSTRIAL COMMODITIES

(1982 = 100)

Year	Industrial commodities	Pulp, paper, and products*	Woodpulp	Wastepaper	Paper	Paper-board	Converted products
1988	106.3	124.9	136.7	183.6	123.2	133.2	123.0
% change	3.6%	9.3%	22.6%	1.2%	10.5%	12.8%	7.2%
1987	102.6	114.3	111.5	181.4	111.5	118.1	114.7
% change	2.6%	6.2%	17.7%	27.2%	4.2%	10.8%	4.8%
1986	100.0	107.6	94.7	142.6	107.0	106.6	109.4
% change	-3.6%	0.7%	3.6%	16.0%	0.9%	-1.0%	0.5%
1985	103.7	106.9	91.4	122.9	106.0	107.7	108.9
1984	103.3	107.3	104.8	198.2	105.8	110.4	106.4
1983	101.1	99.3	91.5	115.0	98.5	98.4	100.4
1982	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1981	97.4	99.1	104.8	145.0	97.7	101.2	97.9
1980	88.0	91.7	100.3	172.2	89.7	92.0	90.2
1979	75.7	80.6	82.9	170.5	80.2	79.3	79.4
1978	67.0	71.6	70.3	157.8	72.0	70.5	70.5
1977	62.5	68.6	74.2	154.6	67.8	69.1	66.8
1976	58.4	66.2	75.5	152.6	63.7	69.1	64.3
1975	54.9	62.9	74.8	90.9	60.4	66.8	61.2
1974	49.2	55.9	57.5	219.2	51.9	59.7	54.8
1973	40.3	44.8	33.8	162.9	42.4	45.2	46.0
1972	37.8	41.6	29.4	110.3	40.6	41.4	43.0
1971	36.5	40.4	29.6	92.5	39.9	40.2	41.5
1970	35.2	39.7	28.9	103.2	38.8	39.7	40.8
Average annual rate 1970-88	6.5%	6.7%	10.4%	8.9%	6.8%	7.3%	6.4%

* Excludes construction grades.

Source: Bureau of Labor Statistics.

off, while competition from other publications grades (also selling for less because of overcapacity) made already soft markets worse. The economic recovery boosted consumption, allowing producers to push the list price back up to $500/ton in mid-1983, but transaction prices did not firm to that level until the ten-week British Columbian shutdown in the first quarter of [illegible].

Another price hike later in the year brought newsprint to a list of $535/metric ton, but slower growth and publisher inventory building combined to thwart an attempted increase in January 1985. Mills tried to raise prices another six times in 1985, but all of these attempts failed. Discounting increased as markets remained soft and as imports of cheap offshore newsprint picked up.

Gradually improving demand helped markets firm up in 1986, and producers were finally able to push through a price hike in October to a list of $570/metric ton, although the increase was not implemented fully until early 1987. Markets continued to strengthen throughout 1987, and producers were able to increase prices on July 1 by $40 to $610/ton. This was followed on Jan. 1, 1988, by another hike of $40 to $650/ton.

Transaction prices continued to be significantly below list during this time, ranging between $570 and $610/metric ton at the beginning of 1988. This proved to be the peak of the latest cycle for newsprint producers, who saw market prices erode in 1988 to an average transaction level of $600/ton, followed by an additional $30/ton drop in first-half 1989 due to sluggish demand and to anticipated capacity additions through 1990.

Coated paper. Heavy demand kept the coated groundwood industry running virtually flat out in the late 1970s, allowing a steady series of price increases after the 1974-75 recession. However, a heavy influx of new capacity and lower demand caused prices to flatten in 1981 and 1982, forcing a price rollback in early 1983. Demand quickly outpaced new capacity as the recovery picked up steam, allowing producers to restore prices and push through two increases in 1984. Demand for coated free-sheet was almost as strong, and mills were able to raise prices in fourth-quarter 1983, in January 1984, and again in second-quarter 1984.

Coated groundwood producers raised prices again in early 1985, but fewer orders and import pressure sent prices back to late-1984 levels by early 1986. Overcapacity struck both free-sheet and groundwood grades later that year, although strong demand growth helped cushion the effects, especially for premium grades. By early 1987, both sectors were forced to roll back prices.

That distressing market situation turned around quickly at the end of the second quarter, helped by the conversion of some groundwood tonnage to free-sheet and by the temporary production of uncoated papers by a few producers. A price increase of $50 to $70/short ton was implemented successfully on July 1 for coated groundwood grades, and demand continued to soar through the end of 1987. That strength continued in 1988, with prices moving up 6% for No. 4 coated (50 lb, in rolls) and nearly 20% for No. 1 coated (70 lb).

Discounting crept into the picture by early 1989, however. A July 1 hike that would have boosted list levels by an average of 5% had to be rescinded. With additional capacity coming online later in the year, prospects were not good for another hike in 1989.

Uncoated free-sheet. Uncoated free-sheet prices came under heavy pressure during the recession, with deep cuts in prices for all but the premium grades. As with coated papers, however, the booming recovery allowed producers to regain lost ground. Prices went up in the last quarter of 1983 and again in the following quarter.

Cheap imports and a spurt of new capacity toward the end of the year undercut prices during 1984. By the end of the year, 50-lb offset was down as low as $560/short ton, where it remained until prices in general began to improve in mid-1985. As 1985 progressed, prices firmed across the spectrum of uncoated free-sheet, and in April and July of 1986, producers raised them. Demand was strong enough to support the price increases despite overcapacity caused by completion of several major expansion projects.

In the first half of 1987, that new capacity came back to haunt producers, as prices plummeted in the face of weakened demand. An attempted price hike failed at the end of the first quarter, sending prices back to late-1986 levels with sales typically about $80/short ton below list. Overcapacity and competitive price cutting delayed another increase until September 1, by which time markets had tightened considerably thanks in part to labor problems. Throughout most of 1988, mills were able to pass along one or more price increases. For example, 50-lb offset (rolls) shot up by 17% between Jan. 1, 1988, and a year later; however, the $900/ton list stagnated during the first six months of 1988 while discounting escalated to as much as $160/ton. By mid-1989, it was apparent that the market was slowing for virtually all uncoated free-sheet sectors. Even grades previously on allocation, such as cut-size repro, were loosening up.

Brown paper. Unbleached kraft paper has been the weakest segment in recent years, particularly the heavier-weight grades, which are subject to competitive pressure from swing linerboard machines producing kraft papers during slow periods. Prices for 70-lb grocery sack paper fell from a prerecession peak of about $310/short ton to a discounted $240/ton in late 1982. Multiwall kraft sack paper also suffered during the downturn due to weakness in key markets such as construction and agriculture. Prices picked up along with the economy in 1983, as swing machines returned to linerboard production and as inventories dropped to normal levels.

With mills running full, producers were able to push through sharp runups in some grades. Grocery sack prices surpassed prerecession levels in early 1984, but another increase to bring prices into parity with lightweight linerboard by early summer never fully took effect. A $30/short ton first-quarter increase for multiwall sack paper prices also failed to take hold, as agricultural and construction markets remained sluggish.

Grocery bag and sack paper prices began to deteriorate in late 1984 as the linerboard market softened, and multi-

SELECTED U.S. PULP, PAPER, AND CONVERTED PRODUCT PRICES

	$/short ton domestic market—unless otherwise indicated					Percentage change from year earlier			
	4th Q 1988	4th Q 1987	4th Q 1986	4th Q 1985	4th Q 1984	4th Q 1988	4th Q 1987	4th Q 1986	4th Q 1985
PULP ($/metric ton)									
Bleached softwood kraft—northern	$760	$610	$480/520	$400*	$510*	24.6%	22.0%	25.0%	-21.6%
Bleached softwood kraft—southern	735/740	585	490	360	475	26.1	19.4	36.1	-24.2
Bleached hardwood kraft—southern	685/695	565	460	320*	450*	22.1	22.8	43.8	-28.9
PAPER									
Newsprint (30-lb East)	(544)*	(517)	454/499*	485*	485	5.2	8.5	-1.8	n.c.
Directory (22.5-lb white)	850	720	670	670	670	18.1	7.5	n.c.	n.c.
Coated publication paper									
No. 1 (+70-lb sheets)	1,560/1,600	1,440/1,460	1,375*	1,375*	1,310/1,375	9.0	5.5	n.c.	2.4
No. 5 (34-lb rolls)	990/1,000	890	860*	931*	890	11.8	3.5	-7.6	4.6
Uncoated free-sheet									
Book paper (No. 3 offset, +45-lb sheets)	1,020	850	850	800	880	20.0	n.c.	6.3	-9.1
No. 1 (watermarked, +20-lb sheets)	1,090/1,100	960	985	985	985	14.1	-2.5	n.c.	n.c.
Forms bond (15-lb rolls)	(880)/910	760	720	600	693	17.8	5.6	20.0	-13.4
Tissue (BLS index)	117.1	114.3	109.7	104.7	97.5	2.4	4.2	4.8	7.4
Unbleached kraft shipping sack (+50 lb)	510/520	480/490	(420/430)	360/375*	390/410*	6.2	14.1	15.6	-8.1
PAPERBOARD									
Unbleached kraft linerboard (42-lb East)	410	380	320	250/260	320/350	7.9	18.8	25.5	-23.9
Semichemical medium (26-lb East)	(390)/400	350/360	290/300	240	310*	11.3	20.3	22.9	-22.6
Folding boxboard									
Clay-coated recycled (20-pt rolls)	440/460	390/430	380/420	350/400	370/425	9.8	2.5	6.7	-5.7
Solid bleached sulfate (15 pt, C1S, 80 brite, rolls)	720/740	625/660	570/625	500/590	590/665	13.6	7.5	9.6	-13.1
CONSTRUCTION GRADES									
Building paper & board (BLS index)	112.8	113.6	109.9	106.3	106.4	-0.7	3.0	3.4	-0.1
CONVERTED PRODUCTS									
Corrugated price trend (FBA index)	125.5	118.4	104.5	100.6	112.5	6.0	13.3	3.9	-10.6

* = Discounting below list prices.
( ) = Estimated transaction prices where most volume is moving significantly below list.
n.c. = No change.
n.a. = Not available.

Sources: *Pulp & Paper Week*, Bureau of Labor Statistics, Fibre Box Assn.

wall shipping sack paper prices also weakened further. By spring 1985, renewed swing production on linerboard machines had pushed the price of 70-lb grocery sack paper down to $260/short ton or less. By summer, some multiwall paper was discounted to $360/ton and lower.

Closure of several kraft paper machines tightened the supply/demand balance beginning in mid-1985, and producers responded with a steady stream of increases on grocery bag and sack grades. As demand stayed strong, loss of market share to plastics was the only constraint on prices. Grocery bag and sack paper prices rose in September 1985, and producers pushed through successive increases in January, April, and October 1986, as well as in February 1987. Multiwall sack paper prices also climbed, with increases during the first and third quarters of 1986 and the first quarter of 1987.

The February 1987 increases brought 70-lb prices to about $400/short ton (same as lightweight linerboard); prices for 50-lb multiwall paper rose to $450 to $460/ton. Markets stayed very tight into 1987, and kraft paper producers successfully implemented a $30/ton price increase for most grades in September, again on the heels of a linerboard increase. The increase raised 70-lb grocery sack paper to $425 to $435/ton; 50-lb multiwall rose to $480 to $490/ton.

A year later, prices climbed an additional 6% to 7% or more, with 70-lb unbleached kraft paper selling for $455 to $465/short ton and 50-lb shipping sack selling for $510 to $520/ton by Oct. 1, 1988. Another hike was implemented in first-quarter 1989, raising prices about $40/ton across the board. But weakening linerboard markets in the second quarter took a toll on kraft paper by mid-year as more production time became available on swing machines.

RESISTANCE BACK IN PAPERBOARD

Paperboard prices have climbed an average of 6.2%/year during the 1980s, down from an 8.4%/year rate in the previous decade. Hurt by the strong dollar, prices on average declined 4.8% in 1985 and another 1.2% in 1986. Prices bounced back in 1987, however, rising 10.8% because of strong domestic demand and a weaker dollar. This was followed by an additional 12.8% boost in 1988.

Containerboard. Both linerboard and corrugating medium suffered sharp drops during the recession, with 42-lb linerboard prices falling from $300/short ton in early 1981 to $250/ton and lower by late 1982. Corrugating medium took a similar plunge. Prices began climbing again in 1983, but producers were unable to regain old levels until a February 1984 hike to $320/ton.

An increase to $350/short ton attempted in the fall of 1984 only partly took hold because of increasing pressure on the market from the strong U.S. dollar. Containerboard prices began to erode in early 1985, and by summer, linerboard was down to $250 to $260/ton, where it stayed for the rest of the year.

Markets tightened in late 1985 due to healthy box demand, a surge in export shipments, and production curtailments. Linerboard prices made a strong recovery in 1986, with the base price of 42-lb board rising from $260/short ton and below in the first quarter to $320/ton by the third quarter. Strong export demand aided by the dollar's decline was a big factor in the upturn. Producers easily pushed through a $30/ton hike in January 1987, returning list levels to their peak of fall 1984. Two other increases later in 1987 raised 42-lb linerboard to $410/ton before zoned discounts. However, a price hike of $40/ton in first-quarter 1989 had to be rescinded due to weakening demand as the economy stagnated and box makers resisted the increase.

Prices for semichemical medium have generally followed the pattern for linerboard, though the differential between both has been a wide $30 to $40/short ton since at least 1988. In second-quarter 1989, 26-lb semichemical medium sold for $380 to $390/ton. Part of the problem was increased competition from Canadian suppliers as a result of the Free Trade Agreement lowering tariffs, plus increased availability of recycled board at prices of about $350/ton.

In Europe, U.S. producers successfully pushed through a $35/metric ton increase on heavyweight board in the fall of 1986, raising prices to $405/ton before duties. Similar increases were successful in March and August of 1987. The $40/ton increase in August brought heavyweight linerboard in Europe to $480/ton c.i.f. in most markets, while the list for lightweight linerboard in Southeast Asia rose to $515 to $530/ton, depending on the country. Gradual weakening in the U.S. domestic market in 1988 caused transaction prices offshore to drop to levels as low as $420 to $430/ton in some markets. The rising U.S. dollar did not bode well for price increases later in 1989.

Boxboard. Although more recession-proof than other grades because of various end uses in food packaging, solid bleached folding boxboard prices also fell in 1982, in part because of competition from clay-coated recycled boxboard mills benefiting from the sharp decline in wastepaper prices. In 1983, some producers tried to return to the $625/short ton list, but the attempt failed. Markets moved up sharply during the last half of 1984, only to erode in 1985. On the recycled side, chipboard prices remained relatively firm during the 1984-85 downturn, but clay-coated board prices were down to the $300/ton range in some spot sales by 1985.

Bleached board prices began to firm up in the first quarter of 1986. Producers raised lists about $30/short ton and began to cut back on discounts. A second round of hikes was successful in the third quarter, but a third attempt at the end of the year failed to gain support. After trying and generally failing to raise prices all year, recycled producers got some relief from high wastepaper prices, with a fourth-quarter increase in all areas of the country except the West Coast.

After some initial difficulty, producers raised bleached board prices again in the spring of 1987, bringing folding carton stock prices up $30/short ton to a new list of about $645/ton. West Coast recycled board producers also pushed through a price hike, their first in over two years. Bleached board producers took advantage of a pickup in business in late summer to announce another increase of about $35/ton, effective in the fall. At the same time, recycled boxboard producers in the Midwest implemented price hikes, raising transaction prices to $390 to $430/ton for most business.

In 1988, bleached board producers increased prices by $40/short ton in April and by $55/ton in September, raising the price of 15-pt board to $730/ton by year-end. This was followed by two $50/ton hikes in January and August 1989, which raised the list to $830/ton.

Recycled board producers were equally aggressive in 1988, raising prices of folding carton stock three times. Prices for 20-pt clay-coated board increased about $100/short ton to $500/ton by year's end. The momentum did not carry over into 1989, however.

Wastepaper. Wastepaper prices are the most volatile in the paper industry, fluctuating wildly in response to supply and demand. The average annual growth rate for the 1980-88 period was 5.3%, compared with 12.4% during the 1970s. Prices dropped 16% in 1981 and another 31% in 1982, according to BLS data. A 15% increase in 1983 was followed by the largest gain of the decade—72% in 1984. Wastepaper prices plummeted 38% in 1985 before rising 16% in 1986 and 28% in 1987. In 1988, the cycle began to change again, and the BLS wastepaper price index moved up just 1.2%.

CONVERTED PRODUCTS SLOW TO REACT

Converted products prices have been more stable than primary grades, holding up better during the recession but missing out on the strong recovery afterward. Prices have risen an average of 5.1%/year since 1980, down from 7.8%/year in the 1970s. That is somewhat worse than the performance of paper and paperboard, indicating that converters have been unable to entirely pass on raw materials price increases and maintain profit margins over the long term.

Converted products price indexes outperformed paper and board in the recession years, rising 2.1% in 1982 and 0.4% in 1983. However, converters did not keep pace with increases on paper and paperboard in 1984, as converted prices climbed only 6.0% compared with 15.1% for paperboard and 7.4% for paper. Converters again kept pace with their suppliers during the sluggish 1985-86 period, but since then prices have lagged for converted products in comparison with paper and board. The converted products price index for 1988 was up only 7.2% from the previous year, compared with a 12.8% increase for paperboard, suggesting some renewed and substantial pressure on converters' profit margins.

Corrugated box prices tend to follow domestic swings in containerboard prices, as converters try to pass on higher input costs. Containerboard accounts for about 50% to 55% of the cost of producing a corrugated box. Converter profit margins fattened in 1985, when containerboard prices fell nearly 30% and box prices fell only about 12%. Since then, however, box prices have failed to match the steep runup in containerboard prices. After several failed attempts, converters pushed through an 8% increase in the third quarter of 1986. After the January 1987 containerboard price hike, integrated box makers got another 10% increase in box prices in the spring. This returned box prices to near their previous historic high. Under pressure from higher containerboard prices, box makers were fairly successful in pushing through an 8% increase in September. Corrugated box end users saw their box costs rise nearly 9% in 1988 after an 11.5% rise in 1987. In second-quarter 1989, some producers attempted to push through price hikes of 8% to 10% on corrugated boxes; however, with linerboard prices faltering, these attempts were not fail-safe.

United States:

PROFITABILITY

The U.S. pulp and paper industry had another substantially profitable year in 1988, with earnings up by 42.3% on a 14.1% increase in sales, based on a *Pulp & Paper Week* survey of financial reports from 26 companies. This brought the industry's profit margin up to 7.5% in 1988, the highest level attained since 8.8% in 1950, according to preliminary Federal Trade Commission data.

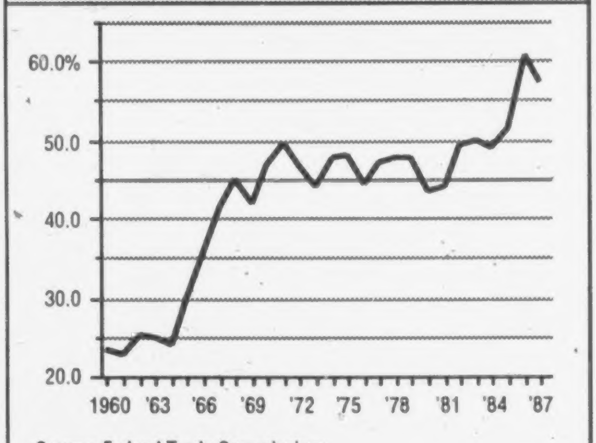
This was the second consecutive year of record profits for many pulp and paper companies. In 1987, earnings surged ahead by 46.0%. Continued strength in markets for virtually all grades of pulp, paper, and paperboard drove up prices; at the same time, mill overhead costs moderated as recent capital investments produced results.

The year 1988, however, brought bigger debt to the industry as financing for capital projects and acquisitions forged ahead. This trend should continue in 1989. Among those companies likely to be near the top of the most-highly-leveraged list in 1989 will be Stone Container Corp., as a result of its $2.2-billion purchase of Consolidated-Bathurst Inc. early in the year.

A new trend to buy back stock appeared to be emerging. Champion International Corp. repurchased roughly 11% of its outstanding stock for approximately $10 million in June 1989. Prior to this, Boise Cascade Corp. announced a buy-back plan through its employee stock ownership program. Some of these moves are also connected with management's takeover defense strategies.

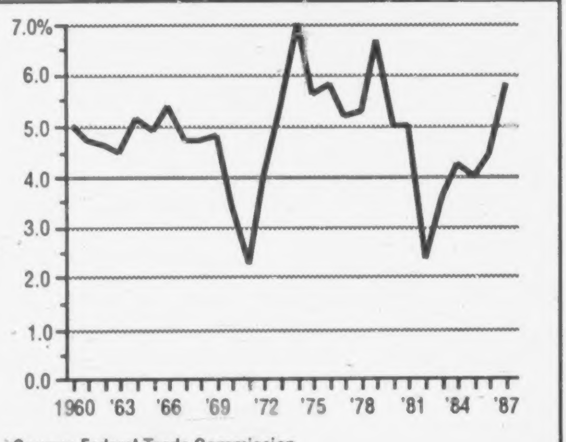
The biggest drain on investment continues to be reinvestment in upgrades or new facilities. This trend has been fueled in recent years by better cash flows resulting from higher company profits. U.S. pulp and paper companies will spend an estimated $13.69 billion during 1988-90, ac-

DEBT TO NET WORTH, 1960-87



Source: Federal Trade Commission.

PROFIT MARGIN, 1960-87



Source: Federal Trade Commission.

cording to *Pulp & Paper* magazine's "1989 Capital Spending Survey." This is a 70% increase from capital expenditures announced for the prior three-year period, 1987-89.

Companies were not very concerned with unusually high debt-to-equity ratios, expecting that profits would continue to generate good cash flows into the foreseeable future. The optimism is understandable given the market conditions in recent years. The industry benefited from continued economic expansion worldwide and a favorable U.S. dollar exchange rate in relation to foreign currencies. The 1985-88 weakness in the dollar alone accounted for 70% of the improvement in domestic paper company earnings over the 1986-88 period, according to Gary Palmero, Oppenheimer & Co. Inc.

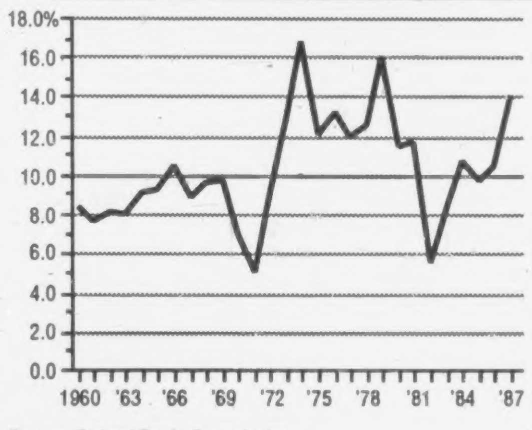
The weak dollar enabled U.S. paper companies to raise U.S. dollar prices with greater ease in overseas markets. Conversely, U.S. producers did not incur the same pressures as mills located in countries where currencies were driving costs upward.

Not only has the dollar's plunge in recent years given U.S. exporters an advantage, it has made the U.S. market less attractive for imports. According to the American Paper Institute, growth in U.S. imports of paper industry products slowed in 1988 to 1%, compared with a more than 7% increase in 1987. Still, on a dollar basis, the U.S. trade deficit in this sector remained about the same as in 1987—$3.2 billion—despite a 15.3% rise in exports in 1988, the third consecutive yearly increase.

ANOTHER RECORD YEAR IN 1988

In 1988, Weyerhaeuser Paper Co. had the highest sales in the industry at $10 billion, a 13.3% increase over 1987. At the same time, earnings were up 26% to $564 million. As one of the top exporters, the company gained substantially from a devalued U.S. dollar. "Sharply higher dollar prices of pulp and paper products traded in world markets drove margins for these products to their highest levels in the 1980s," said George H. Weyerhaeuser, chairman and CEO.

RETURN ON NET WORTH, 1960-87



Source: Federal Trade Commission.

Georgia-Pacific Corp. slipped from sales leader in 1987 to a second-place tie with International Paper Co. in 1988. Both companies sold approximately $9.5 billion. G-P's earnings gain in 1988, however, was up just 2.0% to $468 million, while IP's profits leapt 85% to $754 million.

John A. Georges, chairman and CEO of IP, attributed these record results to strength in the white papers, market pulp, and packaging businesses. Another factor was IP's own improved competitiveness. Investments made to upgrade the company's manufacturing base began to produce quality products more efficiently, said Georges.

In 1988, Champion's returns increased 19.4% to $456 million on sales of $5.1 billion, thanks to improved results in domestic printing/writing, publication, market pulp, newsprint, and packaging grades. Production curtailments at two mills, however, offset even higher earnings that had been initially projected.

Bowater Inc.'s gain was helped by a continued diversification away from newsprint and into such grades as lightweight coated paper and bleached kraft market pulp. "All our plans made since we became public in 1984 bore fruit," said Anthony P. Gammie, chairman and CEO. Net income of $164.3 million on sales of $1.4 billion was more than double the 1987 net income of $81.1 million on sales of $1.2 billion.

Boise Cascade's earnings rose 58% to $289.1 million on sales of $4.1 billion in 1988. Paper and office products businesses remained healthy all year, the company said. However, the building products sector was down from 1987 as a result of reduced demand, increased raw material costs, and an industry-wide labor dispute in the Northwest that affected 15 of Boise Cascade's wood products facilities for nine weeks.

In 1988, Great Northern Nekoosa Corp. celebrated a 70.3% boost in earnings of $341.7 million on receipts of $3.6 billion. "Excellent business conditions prevailed in our industry throughout the year," said GNN chairman William R. Laidig. Fourth-quarter income, though, was reduced by expenses related to labor contract settlements at four GNN mills, maintenance costs that exceeded estimates, and cost overruns at the Maine mills.

STRONG CONTAINERBOARD MARKETS

Stone Container's 1988 earnings catapulted ahead by 111.9% to $341.7 million on sales of $3.74 billion, resulting largely from the robust demand for packaging materials combined with the company's firm grip on costs. A bold player in the acquisitions arena, Stone Container has in recent years expanded and diversified its product line and geographic presence by boosting its debt level, mainly with new purchases. Its payback rate, though, has maintained the company's reputation as a good financial risk.

Gaylord Container Corp.'s 1988 net income shot up 117% to $41.9 million on sales of $671 million. Temple-Inland Inc. had its second consecutive year of record results in 1988, with earnings up 37.9% to $195 million on sales of $1.2 billion. Export shipments, however, were off.

Union Camp Corp.'s 1988 income climbed 42.3% to $295 million on sales of $2.7 billion. Jefferson Smurfit Corp.'s income in 1988 surged 57.1% ahead of 1987's level to $145 million on sales of $1.3 billion. Earnings at Smurfit's 50%-owned affiliate, Container Corp. of America, jumped by 45% to $64.1 million, helping to offset losses from the strike at Smurfit's two newsprint mills in Oregon. Chesapeake Corp.'s profit was up 71% to a record $51.5 million on sales of $711.3 million.

Burnell R. Roberts, Mead Corp.'s chairman and CEO, cited particularly strong markets for coated products and international packaging operations in 1988 as being behind the company's 66.9% increase in earnings—$364.1 million on sales of $4.46 billion.

The tissue/toweling and diaper sector also enjoyed good returns in 1988. Scott Paper Co.'s earnings of $400.9 million on receipts of $4.73 billion in 1988 represented the sixth year of continuous increases and the fifth consecutive year for record-setting profits. In the U.S., however, these record earnings were negatively affected by higher manufacturing costs, increases in advertising and promotional expenses, and some unexpected production difficulties, the company said.

For the fifth consecutive year, Kimberly-Clark Corp. re-

U.S. PAPER AND ALLIED PRODUCTS INDUSTRY FINANCIAL PERFORMANCE, 1960-87

($ million)

					Financial ratios			
Year	Net sales	% change from prior year	Net profit after taxes	% change from prior year	Profit margins	Return on net worth	Return on total capital	Debt to net worth
1987*	$95,576	27.7%	$5,520	68.3%	5.8%	14.1%	9.0%	57.2%
1986*	74,844	4.4	3,280	13.9	4.4	10.5	6.5	60.6
1985*	71,465	-0.2	2,880	-4.1	4.0	9.7	6.4	51.4
1984	71,891	8.8	3,015	29.0	4.2	10.7	7.2	49.0
1983*	65,008	9.6	2,327	60.1	3.6	8.5	5.7	49.8
1982	60,293	-3.5	1,460	-53.0	2.4	5.5	3.7	49.2
1981*	62,699	5.3	3,110	53.0	5.0	11.7	8.1	44.1
1980*	56,250	7.2	2,800	-45.4	5.0	11.5	8.0	43.4
Average 1980-87		7.4		15.2	4.3	10.3	6.8	50.6
1979	55,359	11.4	3,723	40.6	6.7	16.0	10.9	47.5
1978*	48,982	18.5	2,598	18.5	5.3	12.5	8.5	47.6
1977*	45,750	6.8	2,367	-1.6	5.2	12.0	8.2	47.0
1976	39,270	22.6	2,270	26.0	5.8	13.2	9.1	44.3
1975	32,044	4.0	1,801	-17.5	5.6	12.1	8.2	48.3
1974*	32,837	16.2	2,287	51.5	7.0	16.8	11.4	47.5
1973*	26,503	13.6	1,441	53.1	5.4	12.9	8.9	44.2
1972	23,324	4.9	941	83.8	4.0	8.9	6.0	46.8
1971*	22,224	5.5	512	-28.8	2.3	5.0	3.3	49.7
1970	21,069	2.2	719	-27.2	3.4	7.0	4.8	46.8
Average 1970-79		10.6		19.8	5.1	11.6	7.9	47.0
1969	20,607	10.0	987	11.0	4.8	9.7	6.8	41.8
1968	18,738	10.9	889	11.7	4.7	9.6	6.6	45.1
1967*	16,900	-0.7	796	-12.6	4.7	8.8	6.2	41.5
1966	17,016	4.9	911	4.8	5.4	10.5	7.7	35.6
1965*	15,217	9.8	753	15.3	4.9	9.2	7.1	30.0
1964	14,771	5.1	754	18.9	5.1	9.1	7.3	23.7
1963	14,050	2.6	634	1.0	4.5	8.0	6.4	24.9
1962	13,698	9.4	628	7.7	4.6	8.1	6.5	25.1
1961	12,525	6.5	583	-0.7	4.7	7.7	6.2	22.6
1960	11,764	-0.5	587	-5.2	5.0	8.4	6.8	23.3
Average 1960-69		5.8		5.2	4.8	8.9	6.8	31.4

* Revised—change in corporation structure of the industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Definitions: Profit margins = after-tax net profit to net sales. Return on net worth = after-tax net profit to net worth. Return on total capital = after-tax profit to net worth + long-term debt. Debt to net worth = long-term debt to net worth.

Sources: Federal Trade Commission, Securities & Exchange Commission, Bureau of the Census. Compiled by American Paper Institute.

ported record results for its fourth quarter and full year, with 1988 net income up 16.4% to $378.6 million on sales of $5.4 billion. At the same time, the company announced capital spending plans for 1989-90 totaling a record $2.0 billion.

OUTLOOK DIMS IN 1989

The U.S. dollar, in relation to other major worldwide currencies, appeared to be strengthening in 1989. Though still low compared with its position in 1986, the rising U.S. dollar threatened to have some effect on world trade of U.S. paper industry products. At the very least, it would impede the efforts of U.S. mills to further cultivate export markets; with U.S. capacity in many sectors rising over the next few years, domestic producers are looking more seriously at offshore outlets for their products.

Capacity in some industry sectors, such as coated and uncoated free-sheet, remained tight in first-half 1989, resulting in better pricing prospects than for other grades. But even these grades began to weaken at mid-year in anticipation of new capacity coming online later in 1989. Earlier in the year, erosion began to appear in other bellwether grades such as newsprint, linerboard, and market pulp.

Actually, the earliest signals of an impending slowdown in industry profits appeared in fourth-quarter 1988. Although still high, profit margins of many companies shrunk from those reported earlier that year. For example, Bowater's earnings were up 102.6% overall in 1988, but only 54% in the final quarter.

Still, the momentum of substantial profits in 1987 and 1988 managed to overflow into the next year. Earnings were up 21.6% in first-quarter 1989, and most paper-industry executives were bullish on the year's outlook. "We're coming off a fine year, and at this point 1989 looks promising," said Andrew C. Sigler, Champion's chairman and CEO.

Nevertheless, the industry's overall first-quarter rise in earnings was lower than the jumps reported in the first quarters of 1988 and 1987. The upturn that began in 1986 appeared to be leveling off. "It is evident that the paper industry as a whole is peaking out in one of its familiar cycles," said George W. Mead, chairman and CEO of Consolidated Papers Inc.

Earnings overall were expected to be good during 1989, although not as impressive as the results of the two previous years. Many industry observers felt the downturn would be gradual through year-end, followed by a rebound sometime in 1990. Some companies were more optimistic, projecting another excellent year for profits; however, most of these forecasts came from firms with significant capacity in grades such as bleached paperboard and bleached softwood kraft market pulp.

Except for newsprint, prices remained firm during the first half of 1989. However, linerboard and hardwood market pulp producers had trouble implementing increases scheduled for the second quarter, signaling that the industry's upward momentum was running out of steam. Prices for certain grades remained strong; bleached board mills posted a

U.S. PAPER AND FOREST PRODUCTS COMPANY SALES AND EARNINGS, 1988

($ 000)

Companies	Sales	% change 1988/87	Earnings[1]	% change 1988/87
Boise Cascade	$4,094,630	7.2%	$289,120	58.0%
Bowater	1,400,000	16.7	164,300	102.6
Champion International	5,100,000	10.9	456,000	19.4
Chesapeake	711,257	5.3	51,475	70.7
Consolidated Papers	896,804	20.7	149,833	56.5
Federal Paper Board	1,116,941	8.9	143,300	93.7
Gaylord Container (9/3)	671,000	53.2	41,900	117.1
Georgia-Pacific	9,509,000	10.5	467,900	2.0
Great Northern Nekoosa	3,588,100	38.6	341,700	70.3
International Paper	9,500,000	21.8	754,000	85.3
James River (10/25)	5,097,978	13.8	209,010	23.0
Jefferson Smurfit	1,255,273	14.2	144,495	57.1
Kimberly-Clark	5,400,000	10.2	378,600	16.4
Louisiana-Pacific	1,799,400	8.8	135,200	13.8
Mead	4,463,900	6.1	364,100	66.9
Mosinee Paper	231,947	7.4	9,477	65.9
Pope & Talbot	514,980	20.9	31,944	13.6
Potlatch	1,084,000	9.3	112,400	28.3
Scott Paper	4,726,400	14.7	400,900	71.5
Sonoco Products	1,599,751	21.9	96,277	56.6
Stone Container	3,742,489	15.8	341,786	111.9
Temple-Inland	1,750,000	0.4	195,000	37.9
Union Camp	2,660,918	12.7	295,146	42.3
Wausau Paper Mills (11/30)	284,240	13.1	16,005	32.8
Westvaco (10/31)	2,133,899	12.1	200,434	37.1
Weyerhaeuser Paper	10,000,000	13.3	564,445	26.4
Willamette Industries	1,716,021	19.9	161,087	32.8
Total	85,048,928	15.1	6,315,834	52.2

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years.

Source: *Pulp & Paper Week.*

price hike of $50/ton for August 1, although buyers were resisting.

With the U.S. economy slowing down in 1989, demand was off for most grades. Yet, mills continued to operate at high rates of capacity, even in newsprint. Some of the slack was relieved by moving more shipments offshore, but the rising U.S. dollar plus increasing worldwide capacity in many sectors were expected to make the export market more competitive.

The firm dollar combined with global economic malaise have eased operating pressures on international pulp and paper producers. As a result, pricing momentum overseas slowed to a standstill by mid-1989, further reducing the likelihood of mills raising prices in the U.S.

Champion's Andrew C. Sigler said he was generally optimistic that 1989 would be a good year for earnings. Although some grades such as newsprint would be weak, overall prospects for other products remained good, provided the economy stayed "reasonably favorable."

IP's John A. Georges said, "We believe prospects are favorable for continued economic expansion of the U.S. economy through 1989, and are optimistic that the company will have another very good year. Furthermore," he said, "we are continuing to focus on improving performance in the areas we can influence, such as the production of high-value products, the productivity of our work force, and the efficiency of our manufacturing facilities."

BETTER POSITIONED FOR DOWNTURN

The industry overall is not unprepared for a downturn, apparently having learned its lesson during the early-1980s slump. "We're in a much better position to withstand a downturn than we were in 1982," said Sigler. In recent years, Champion has sold off most of its solid wood facilities and invested more in pulp and paper, particularly bleached printing/writing grades.

"We are positioned to do better than we have in past downturns," agreed Georges. IP claimed it owes its record profits in 1988 "in large part . . . to our decision to rebuild our manufacturing base," and the company said it plans to invest over $900 million in 1989 to further modernize its facilities.

Mead, too, has built a buffer for hard times by diversifying and concentrating on high-value products where it can create a special niche. "We are confident the significant investments we are making in coated paperboard, electronic publishing, and color imaging products will add new vigor to the earnings stream throughout the 1990s and beyond," Burnell R. Roberts said.

A greater focus on export markets, with an eye toward building an ongoing overseas customer base and toward acquiring facilities in foreign countries, is giving U.S. companies a better competitive edge.

Westvaco Corp., for example, has cultivated its export sales to a growth rate of 90% over its last three fiscal years, compared with a 25% growth rate in overall sales. In the tissue/toweling and diaper sectors, James River Corp. and Scott Paper are aggressively pursuing this strategy, with good results. "We are optimistic about both the short- and long-term outlook for our business," said Philip E. Lippincott, Scott's chairman and CEO.

Innovation in product and customer service has been a key element in Westvaco's strategy. In 1988, $55 million was spent on product-related research, on top of $15 million spent to study processes. "We know of no other organization in our field which is conducting programs of similar breadth and strength," said John A. Luke, president and CEO. "We feel our programs are achieving competitive advantage for our company, and that they will bring significant shareholder values."

Reorganization is still another way to bolster competitive strength, U.S. companies are finding. Despite its record profits in recent years, Weyerhaeuser announced early in 1989 that it would review each segment of its operations. John W. Creighton, president and COO, said the result would probably be "a significantly changed Weyerhaeuser," with "fewer and a less complex group of businesses." However, it is unlikely that any spinoffs would involve pulp and paper assets, as 1988 earnings in this division increased 41% from the prior year.

Despite these added competitive advantages, the outlook for the industry's overall 1989 results was not bullish. "Most of our 1989 estimates are quite conservative," said George B. Adler of Smith Barney.

HISTORICAL PERFORMANCE

U.S. pulp and paper producers especially enjoyed the upturn in their markets in recent years after having endured years of hardship in the early 1980s. Earnings declined almost 63% between 1980 and 1983 in the worst recession of the postwar period. Federal Trade Commission data show that U.S. paper and allied products earnings fell 53% in 1982 alone, twice the decline of 21% suffered in the 1974-75 downturn and on par with the recession of 1970-71 when profits tumbled 56% over the two-year period.

Forest products operations were the first to suffer during the last recession, when the worst housing decline since World War II began in 1979. Profits on the paper side began to evaporate in the fourth quarter of 1981, as weak demand forced sharp price discounting in major grades. Paper company net income declined 8% in 1981 on sales that were up 6% from a year earlier, while forest products companies suffered a 28% drop in earnings for the year. In the depths of the 1982 recession, paper company profits plummeted an additional 47% on sales that were off by 7%, while forest products income plunged 65%.

After six consecutive quarters of decline, paper industry earnings began to show faint signs of recovery in the second quarter of 1983, rising 67% above year-earlier levels. Forest products companies got a much-needed lift from a jump in housing starts and from higher prices for building materials, which boosted profits 73% above 1982 levels. Although lumber prices collapsed in the third quarter due to overcapacity, paper shipments—and prices—improved steadily, and paper products and forest products companies posted increases of 34% and 90%, respectively. As the economic recovery gathered steam late in the year, industry profits took off, rising sixfold among paper companies and almost tenfold for forest products firms. U.S. paper companies finished the year with profits up 45% compared to 1982, while forest products firms enjoyed a 90% increase.

Profits continued to improve dramatically as the economy boomed in early 1984, and several companies set new records for sales and earnings. Paper companies posted a 59% increase in first-quarter net income. Second-quarter figures were even more spectacular as paper company profits jumped 88%, compared with the year before, on sales that were up 32%.

Signs of an economic slowdown began to appear in the third quarter of 1984, however. Paper industry production started to weaken in the fourth quarter, and price discounting began to occur in uncoated free-sheet and in market pulp, reflecting excess capacity and the strong dollar. But industry performance was not hurt too much by these factors, and for 1984 as a whole, earnings jumped 45% on sales that were 15% higher than in 1983.

Overcapacity in some segments and the strong dollar plagued the industry in 1985, causing another downturn in sales and earnings. First-quarter profits were up only 3% on a 6% rise in sales. While coated paper markets stayed strong, uncoated free-sheet suffered from discounting, and prices for market pulp and linerboard remained weak. Second-quarter earnings dropped 19%, as only those concentrated in coated papers or consumer tissue were able to post gains. U.S. industrial activity remained sluggish in the third quarter, and demand weakness spread to newsprint and some coated grades as papermakers' profits plunged 44%. Ending a year of tough competition and difficult markets, 30 top companies reported earnings down 15% compared with 1984 and sales up a minimal 2%.

Sales and earnings bounced back in 1986, thanks to the steady weakening of the dollar, which began to drop in the fall of 1985. The cheaper dollar helped to firm up export shipments and pricing, which in turn helped the domestic supply/demand balance for many commodity grades and allowed producers to push through some price increases. Cost controls in force at many mills also contributed to improved performance. The first quarter marked the trough of the earnings cycle, as profits dropped another 24% due to continued price weakness in several grade segments. Second-quarter income rose 13%, the first increase since the fourth quarter of 1983, and third-quarter profits soared 30% above the previous year on a sales increase of 5%. For the entire year, earnings climbed a solid 34% over 1985 on sales that improved by 4%. Producers of market pulp, linerboard, and uncoated free-sheet showed the biggest gains.

The upturn continued through 1987, bolstered by favorable economic and market conditions. Profits surged ahead in each of the quarters, ending the year with earnings 45.8% ahead of 1986 on an increase in sales of 19.7%. In 1988, weakness began to creep into sectors such as newsprint and wastepaper. It was not until second-quarter 1989 that the change in the cycle became apparent in other grades.

FINANCIAL RATIOS

After lagging the average for all manufacturing for two decades, paper industry return on net worth exceeded the average of the 1974-75 tight-market period. Return on net worth reached a peak of 16.8% in 1974, hovered in the 12%-to-13% range from 1975 to 1978, and then hit 16.0% in 1979, according to FTC data. Return on net worth then declined to the 12% level in 1980 and 1981 before plummeting to 5.5% in 1982. Since then, industry return on net worth has been rising on the strength of slowly improving profit margins. The ratio topped 10% in 1984 and 1986, reached 14.1% in 1987, and appeared to have set a new record in 1988 at 18.8%, according to FTC's preliminary data.

Return on total capital (net worth plus long-term debt) has not kept up with return on net worth, reflecting the heavy debt loads built up by the industry. Long-term debt as a percentage of net worth rose from the low-20% range in the first half of the 1960s to an average of 47% in the 1970s. In 1982, debt to net worth rose to 49% when profits crumbled.

Deterioration in this and other financial ratios caused downgrading of credit ratings for several major producers. Some companies moved to improve their liquidity in the subsequent upswing, but many major producers remain highly leveraged, with some taking on even more debt to finance large acquisitions. FTC data through 1988 show that debt to net worth has continued to climb, topping 51% in 1985 and then soaring to 61% in 1986. It eased slightly to 57% in 1987 but jumped to a new high of 63% in 1988.

United States:

CAPITAL SPENDING

Nineteen-hundred eighty-nine will be another record year for capital spending in the U.S. paper industry, as companies continue investing heavily to expand capacity, cut costs, improve product quality, and meet environmental standards. Despite indications that markets may have peaked, prices and volume remain strong, and early signs point to another year of record spending in 1990.

According to the Bureau of Census, U.S. pulp and paper companies planned to spend a record $15.12 billion in 1989 on new plants and equipment, a level 34.6% higher than in 1988. The paper industry plans the biggest percentage increase among all manufacturing industries, leading every one except air transportation by a wide margin.

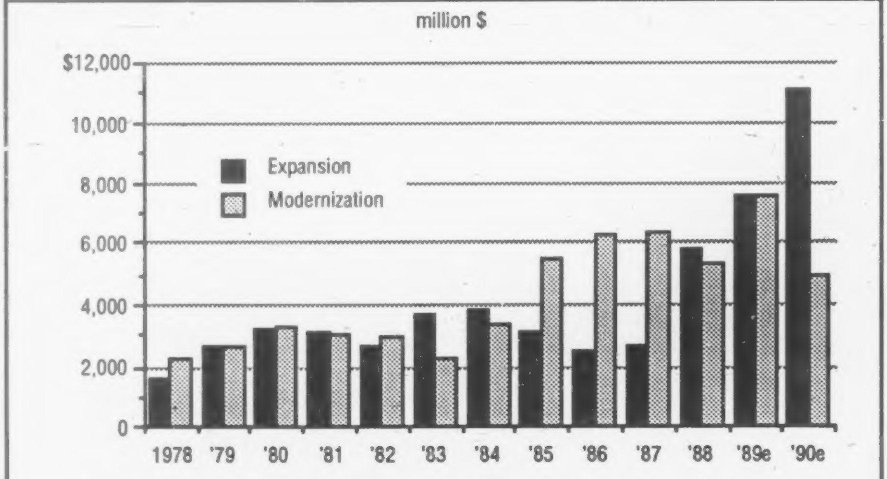
Spending that was lower than expected in the first quarter caused a slight downward revision in the spending forecast made at the beginning of the year. On a seasonally adjusted, annualized basis, the paper industry spent at a rate of $14.21 billion in the first quarter—about 8.1% less than expected. Spending plans for the second quarter were revised upward by 2.1% to a $14.86 billion annual rate. Spending was projected at a $15.63 billion rate in the third quarter and at $15.76 billion in the fourth quarter.

The inflation rate in the capital goods sector was heating up in 1989, according to the Bureau of Census. The capital goods deflator for all industries was projected to increase 3.1% in 1989 after rising 0.2% in 1988 and 0.4% in 1987.

According to Data Resources Inc.'s spring survey of capital spending plans, paper industry spending will peak in 1990 just slightly higher than the 1989 total, and then it will fall sharply in 1991. DRI said spending will climb another 1.3% in 1990 to $16.10 billion before dropping a sharp 26.1% to $11.90 billion in 1991.

The 1.3% increase seen for 1990 is the first indication that spending will continue to rise after 1989, since the two previous DRI studies of 1990 spending showed declines. The May 1988 DRI survey forecast that spending in 1990 would drop 28.1% from 1989 levels, while the November 1988 survey forecast a 6.1% drop. The new 1990 forecast

MODERNIZATION VS EXPANSION IN U.S. CAPITAL SPENDING



Sources: Bureau of the Census, Data Resources Inc.

of $16.10 billion is almost double the $8.58 billion forecast in spring 1988.

HISTORICAL TRENDS

U.S. pulp and paper companies have devoted an increasing portion of their funds to capital improvements over the past decade, both to increase capacity and to reduce costs and improve their products in order to remain competitive. In absolute terms, spending has climbed from $5.24 billion in 1979 to $11.23 billion in 1988, an increase of 114%. Capital spending rose from 86% of cash flow in 1978 and 93% in 1979 to well above 100% of cash flow throughout the 1980s. To help pay for this increase, companies have boosted their long-term debt significantly—from $10.08 billion in 1978 to $20.15 billion in 1987.

U.S. paper-industry capital spending dropped 26% in the 1971 recession, but it rose in each of the following ten years, even through the severe 1974-75 economic downturn. During this period, environmental compliance was the major engine driving capital outlays. During the 1972-75 period, between 30% and 38% of total primary industry capital spending went for air, water, and solid-waste control, according to the National Council of the Paper Industry for Air & Stream Improvement.

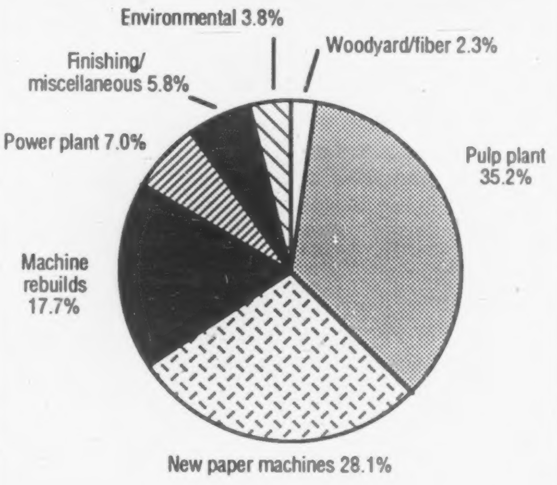
Following the oil-price shocks of the 1970s, a substantial percentage of industry capital was claimed by energy programs to reduce dependence on fossil fuels and to improve efficiency. A *Pulp & Paper Project Report* roundup in late 1981 counted 35 new power boilers and 19 new recovery boilers either being constructed or under consideration at U.S. mills. That number held steady in 1982—although several installations were deferred—before dropping in 1983 because of the recession.

Since then, cogeneration plants have become a major focus of energy spending. In many cases, these plants are being built, owned, and operated by outside contractors; the mill simply supplies fuel for the plant and takes the power generated. Because of such arrangements, interest in this type of project has remained strong despite lower energy prices in the 1980s.

Skyrocketing costs. Rapid inflation in construction and capital-goods costs was another major factor in the 14%/year rise in industry capital spending during the 1970s. The following comparisons, though inexact, show how the costs of building new greenfield mills in several key grades have escalated. In 1971, Weyerhaeuser Co. built a new 1,600-tpd containerboard mill at Valliant, Okla., for about $100 million, or about $62,500/daily ton. Ten years later, International Paper Co.'s 2,070-tpd Mansfield, La., mill was completed for about $600 million, or about $290,000/daily ton. Mead Corp. will complete work in 1990 on a 1,000-tpd unbleached kraft boxboard and linerboard mill at Mahrt, Ala. The new facility is expected to cost $556 million, or about $556,000/daily ton.

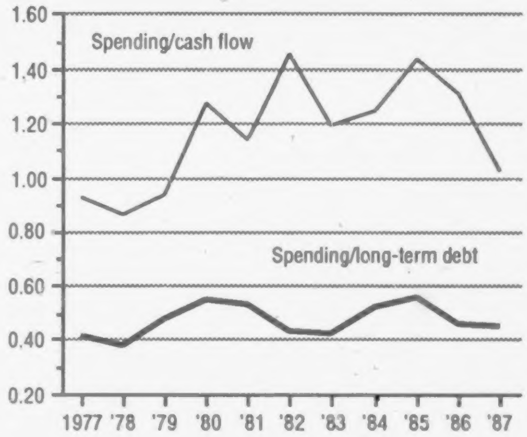
Weyerhaeuser completed a 600-tpd kraft market pulp mill at New Bern, N.C., in 1970 for $50 million, or $83,000/daily ton. Great Northern Nekoosa Corp.'s 1,030-tpd greenfield Leaf River market pulp mill, started up in 1984, cost $560 million, or roughly $544,000/daily ton. Parsons & Whittemore Inc. is building a new 1,400-tpd bleached softwood kraft market pulp plant at its existing mill complex at Claiborne, Ala. Slated for startup in 1991, the $700-million facility will cost about $508,000/daily ton.

ESTIMATED CAPITAL SPENDING AT EXISTING MILL SITES, BY PROCESS AREA



Source: Pulp & Paper Project Report.

RATIO OF CAPITAL SPENDING VS CASH FLOW AND LONG-TERM DEBT



Sources: American Paper Institute, Federal Trade Commission, Bureau of the Census.

Started up in 1984, Union Camp Corp.'s integrated 600-tpd uncoated free-sheet mill at Eastover, S.C., cost $485 million, or $808,000/daily ton. In contrast, Champion International Corp. built a $100-million, 500-tpd bleached kraft pulp and paper mill at Courtland, Ala., in 1971 for $200,000/daily ton. Union Camp is currently expanding the Eastover mill in a $700-million program (about $631,000/daily ton) to add 290,000 tpy of uncoated free-sheet and 105,000 tpy of bleached kraft market pulp. Willamette Industries Inc. is building a 200,000-tpy uncoated free-sheet mill at Bennetsville, S.C., for an estimated cost of $325 million, or $578,000/daily ton.

SPENDING PLANS: 1989 AND BEYOND

Capital spending continues to boom, despite increasing evidence that the economy is slowing. According to *Project Report*, by mid-1989 U.S. mills had announced plans to spend $13.87 billion on expansion and modernization projects during the 1989-92+ period—an increase of 51% over plans in mid-1988. Proposed projects—under active consideration but with no firm startup date—add another $2.69 billion to current spending plans. These spending figures are conservative because they do not include projects for which no dollar amount has been released.

Projects scheduled for startup in 1989 account for $2.73 billion of total planned spending, 1990 startups account for $4.84 billion, and 1991 startups account for $3.56 billion. With most projects targeted for completion in the early 1990s, this pattern suggests that spending will remain high after 1989, despite the fact that markets have cooled off. Several very large expansion programs were announced during the first half of 1989, and producers appear committed to strong spending programs.

Record earnings and continued strong demand are the most important factors in the investment upswing. Capital spending is tied strongly to cash flow, and companies expect another good year of high prices and strong demand, which will keep cash flows high and provide funds for higher capital outlays.

Capacity expansion is the focus of a growing number of spending programs, across virtually the entire spectrum of grades. Newsprint leads the capacity expansion boom, but other grades are also heating up. High prices and tight markets have led to renewed expansion activity in the containerboard sector, which saw below-average growth for most of the 1980s. The coated paper sector is also heating up, with a new coated free-sheet machine recently approved by Consolidated Papers Inc. and six coated groundwood machines under consideration elsewhere. Recycled grades are coming under increasing scrutiny due to the landfill crisis. Garden State Paper Co. Inc. and Smurfit Newsprint Corp. have announced that they are studying new recycled newsprint mills for the hard-hit northeastern U.S., and several recycled paperboard mill proposals are also under consideration for that region.

High market pulp prices have increased the number of projects to expand pulp tonnage for both internal use and sale. Spending in the pulp mill is now estimated at $4.29 billion in the U.S.—double the level in 1988. In many cases, expansion projects have been linked to environmental improvements lowering TRS (total reduced sulfur) emissions, complying with stricter odor regulations, and reduc-

CAPITAL SPENDING PLANS OF MAJOR U.S. PAPER COMPANIES

(million $)

	1989	1988	Change (%)
Boise Cascade	$700	$452	54.9%
Bowater	360	214	68.2
Champion International	850	571	48.9
Chesapeake	145	72	101.4
Consolidated Papers	91	112	-18.9
Federal Paper Board	425	204	108.3
Georgia-Pacific	630	711	-11.4
Glatfelter	69	48	43.6
Great Northern Nekoosa	500	282	77.3
International Paper	900	645	39.5
James River	675	623	8.3
Kimberly-Clark	2,000*	438	n.a.
Longview Fibre	50	117	-57.4
Mead	650-700	350	92.9
Potlatch	210	114	84.2
Scott Paper	1,450*	509	n.a.
Stone Container	455	137	232.1
Union Camp	600-650	359	74.1
Westvaco	500	393	27.2
Weyerhaeuser	825	860	-4.1
Total	10,460	7,211	45.1

* Projected spending for two-year period, 1989-90.
n.a. = Not available.

Source: *Pulp & Paper Project Report.*

U.S. PAPER INDUSTRY CAPITAL SPENDING FORECASTS FOR 1989

(billion $)

	1989e	1988	Change (%)
Bureau of Census			
Paper and allied	$15.12	$11.23	34.6%
All manufacturing	179.35	165.70	8.2
Data Resources Inc.			
Paper and pulp	15.89	11.24	41.4
All manufacturing	192.02	165.71	15.9

e = Estimate.

Sources: Bureau of the Census; Data Resources Inc.

CAPITAL SPENDING BY U.S. PAPER AND ALLIED PRODUCTS ESTABLISHMENTS

(million $)

Year	Total (SIC 26)	Pulp mills	Paper mills	Paperboard mills	Converting plants Paper	Converting plants Containers and boxes	Building paper/board mills
1986	$6,084	$875	$2,153	$1,000	$1,247	$799	$10
1985	6,276	745	2,484	1,043	1,218	764	21
1984	5,302	600	2,412	680	906	681	21
1983	4,987	916	2,239	527	820	470	15
1982	5,098	659	1,856	1,287	786	496	15
1981	5,202	522	2,435	974	746	499	27
1980	5,128	250	1,897	1,539	775	628	40
1979	4,447	240	1,714	1,229	725	491	48
1978	3,736	195	1,424	1,000	604	496	19
1977	3,295	301	1,115	934	507	421	17
1976	3,010	375	1,044	844	394	335	12
1975	2,718	294	832	807	412	347	26
1974	2,214	136	723	637	315	342	63
1973	1,530	119	508	344	304	227	26
1972	1,335	136	372	314	289	206	19
1971	1,197	135	374	228	262	180	18
1970	1,397	122	503	239	289	227	18

Source: Bureau of the Census.

U.S. PAPER AND ALLIED PRODUCTS COMPANIES' CAPITAL SPENDING RELATED TO PROFITABILITY AND CAPACITY UTILIZATION

Year	Capital spending[1] (million $)	Change (%)	Net profit after taxes[2] (million $)	Change (%)	Operating rate[3]
1988	$11,230	24.7%	$8,081	46.4%	95.3%
1987*	9,010	2.7	5,520	52.1	95.2
1986	8,770	2.1	3,280	13.9	93.7
1985*	8,590	19.1	2,880	-4.1	90.3
1984	7,210	21.8	3,015	29.0	93.6
1983*	5,920	5.7	2,327	60.1	91.4
1982	5,600	-8.3	1,460	-53.0	84.6
1981*	6,110	-6.3	3,110	53.0	91.1
1980*	6,520	24.4	2,800	-45.4	91.9
1979	5,240	37.9	3,723	40.6	94.5
1978*	3,800	9.2	2,598	18.5	92.8
1977*	3,480	16.4	2,367	-1.6	91.4
1976	2,990	2.0	2,270	26.0	89.7
1975	2,930	1.7	1,801	-17.5	79.8
1974*	2,880	44.7	2,287	51.5	93.7
1973*	1,990	36.3	1,441	53.1	96.9
1972	1,460	13.2	941	83.8	96.4
1971*	1,290	-25.9	512	-28.8	91.9
1970	1,740	6.9	719	-27.2	91.5

* Revised for change in corporate structure of the industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Sources: 1. Bureau of the Census; 2. Federal Trade Commission; 3. American Paper Institute (Paper and Paperboard only).

ing dioxin output. As a result, several bleached kraft mills are undergoing sweeping modernization programs.

This upswing in expansion plans is a recent phenomenon, with many of the largest projects gaining approval in mid-1989. Most of the increases will come online in 1990 or later.

Paper machine rebuilds also reflect a big pickup in capacity expansion plans. Mills reported plans to spend $2.16 billion on paper machine modification projects during the 1989-92 period. Machine upgrades have played a major role in the industry's modernization efforts ever since the current economic expansion began in 1982, but most of the activity has been in cost-cutting, product improvement, and grade realignment. New expansion plans based around rebuild projects have reversed this trend.

Rebuilds will contribute the most to new capacity in the paperboard sector, where few new machines are currently scheduled. Kraft linerboard has been a recent focal point for incremental expansion activity—especially through installations of high-pressure presses—and this type of project is spreading to corrugating medium machines as well. Linerboard mills extensively rebuilding paperboard machines include Georgia-Pacific Corp., Monticello, Miss.; Union Camp, Montgomery, Ala.; Temple-Inland Inc., Rome, Ga., and Orange, Texas; Great Northern Nekoosa, Cedar Springs, Ga.; and Stone Container Corp., Port Wentworth, Ga.

Spending for power plant improvements in the U.S. industry has not kept pace with the explosion in overall capital spending plans, as the emphasis among papermakers has shifted from cost containment to capacity expansion. U.S. mills now report plans to spend $856 million on energy projects during the 1989-92 period, an amount comprising just 7% of currently planned outlays. Mills concentrated heavily on reducing energy costs ten years ago, leaving less room for improvement at present. A related factor is lower prices for oil and natural gas, which has caused the postponement of several energy conservation and fuel conversion projects.

New paper machines account for 28% of spending plans at existing mills, with outlays estimated at $3.42 billion. Reported planned spending for greenfield mills during the 1989-92 period totals $1.69 billion. The capacity expansion boom has led to a virtual explosion of new paper machine announcements. Nineteen new paper machines at existing mills and nine more at greenfield mills are due for startup during the 1989-92 period. The most active grades for new machines are tissue, coated and uncoated free-sheet papers, newsprint, and kraft paperboard.

In the newsprint sector, Newsprint South Inc. is building a $320-million facility at Grenada, Miss.; Ponderay Newsprint Co. will complete a $300-million facility at Usk, Wash.; and Southeast Paper Mfg. will bring online a new recycled newsprint machine at Dublin, Ga. Two new tissue mills are also scheduled for completion in 1989: Kimberly-Clark Corp.'s $150-million facility at Jenks, Okla., and FSC Paper Co.'s $62-million mill under construction next to its existing recycled newsprint facility at Alsip, Ill. The other major installation scheduled for startup in 1989 is Blandin Paper Co.'s $344-million modernization and lightweight coated paper expansion at Grand Rapids, Minn.

Thirteen new paper machines are scheduled to come online in 1990—seven at existing mills and six at greenfield facilities. Besides Mead's new mill (mentioned earlier), Gaylord Container Corp. will complete a new 1,000-tpd linerboard machine at Bogalusa, La.—the first new linerboard unit to be built since 1985. Union Camp's $375-million modernization and expansion project at Savannah, Ga., will replace two older units with a new kraft linerboard machine.

Boise Cascade Corp. is undertaking an extensive $525-million modernization and expansion program at International Falls, Minn., to add uncoated free-sheet capacity, and it is planning a $450-million coated groundwood program at Rumford, Maine. Champion International is installing a new coated free-sheet unit at its Quinnesec, Mich., market pulp mill, and Scott Paper Co.'s S.D. Warren Div. is building another lightweight coated free-sheet unit at Skowhegan, Maine. Alabama River Newsprint Co., a joint-venture of Abitibi-Price Inc. and Parsons & Whittemore, will bring online a newsprint mill at Claiborne, Ala., which is expected to cost $320 million.

United States:

CAPACITY EXPANSION

In its overall dimensions, capacity expansion in the paper industry behaves in classically cyclical fashion, with each grade responding to changes in its own supply/demand equation. During periods of strong demand, production begins to put a strain on supply, and prices rise, providing companies with the profits necessary to add more capacity. Complicating the picture are the huge amounts of capital and the long lead times required to bring new tonnage online—two or three years and from $300 to $500 million for a new mill, for example.

Even more volatile cycles have occurred during the 1970s and '80s because of exchange-rate fluctuations, which can completely turn around a country's competitive position. With such forces at work, it is not surprising that expansion cycles often get out of hand, especially in commodity grades such as newsprint, market pulp, and linerboard that are affected by capacity changes and trade conditions around the world.

In early 1988, supply was tight for most grades, and both prices and profits were high. As a result, many companies announced expansion programs across a wide spectrum of grades.

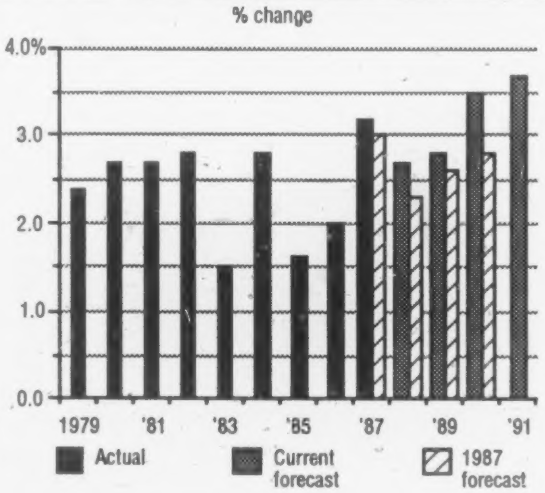
Newsprint is in the building stages of a capacity explosion that will peak in the early 1990s, leading to a period of overcapacity. Kraft linerboard, kraft market pulp, and coated free-sheet paper are all heating up after a period of slow growth.

On the down side of the cycle, uncoated free-sheet capacity will grow more moderately following a period of heated growth during the mid-1980s. Coated groundwood paper expansions will also slow down following a period of sustained, strong growth that ended in 1987.

Less cyclical than other grades, tissue will continue to grow at a moderate pace, while kraft packaging papers will remain in the doldrums due to competition from plastics.

In 1988, producers responded to record prices and strong demand by revising their expansion plans upward for the second straight year. The U.S. paper industry will add 8.2 million short tons to paper and paperboard capacity during the 1989-91 period, an average annual increase of 3.3%, according to the American Paper Institute's fall 1988 survey of expansion plans. During the same period, woodpulp capacity will increase by 5.1 million tons for an annual growth rate of 2.6%. Total paper and paperboard capacity will rise to 88.6 million tons by 1991, while industry pulp capacity will climb to 67.8 million tons. Wastepaper consumption is projected to increase about 3.0% annually to

ANNUAL GROWTH RATE OF PULP AND PAPER CAPACITY



Ten-year average for 1979-88: 2.5%.
Average for three-year survey period, 1989-91: 3.3%.

Source: American Paper Institute.

reach 23 million tons by 1991, assuming the industry continues to operate near full capacity.

High industry profitability is fueling an unprecedented capital spending boom in both the U.S. and Canada, which will lead to the largest influx of new capacity in history. Total paper and paperboard capacity rose 3.2% in 1987 alone, the largest single-year increase since 1973, and the pace of growth continues to speed up. Expansion plans for the 1988-90 period are up 18.0% since API's 1987 survey. The 3.3% annual growth forecast in the 1988 survey compares with 2.5%/year in the 1987 report—an increase of 32%.

Some observers fear that this North American expansion boom will lead to overcapacity, especially if the economy turns down. A looming oversupply of newsprint has already given newspaper publishers enough leverage to delay the timing and the amount of the next newsprint price increase. Some analysts also predict an oversupply of market pulp in 1991 or 1992 if all of the proposed worldwide pulp expansions are completed on schedule. Some 40 major market pulp projects with a combined total capacity of 8.0 million metric tons had been announced by mid-1989.

Newsprint oversupply. Most of the industry's major capacity expansions are scheduled to start up in 1990 and 1991, but new newsprint capacity began coming online in 1989, even as newspaper markets were weakening. Newsprint capacity is expected to increase sharply from 6.1 million tons in 1988 to 7.1 million tons in 1991, an annual growth rate of 5.2%. These totals include three new greenfield mills with total capacity of 665,000 tpy to be constructed by Alabama River Newsprint Co., Newsprint South Inc., and Ponderay Newsprint Co., plus a new 230,000-tpy machine installation at Southeast Paper Mfg. Co.'s Dublin, Ga., mill.

Printing/writing papers producers will add 2.8 million tons of capacity during the 1989-91 period, for an average annual growth rate of 3.9%—about even with average annual growth of 4.0% during the preceding ten years. Uncoated free-sheet, the largest segment, will account for 45% of the total expansion with an increase of 1.3 million tons. Projects include new paper machines at Georgia-Pacific Corp., Zachary, La.; Boise Cascade Corp., International Falls, Minn.; and Union Camp Corp., Eastover, S.C. In addition, Willamette Industries Inc. is building a greenfield mill in Bennetsville, S.C., for startup in 1990.

Coated free-sheet is the hottest category among printing/writing papers. Capacity for coated free-sheet will increase by nearly 1.0 million tons through 1991, with average annual growth of 8.8%. Midtec Paper Corp. started up a new free-sheet machine at Kimberly, Wis., in 1988, and Champion International Corp. is adding a free-sheet machine to its Quinnesec, Mich., bleached kraft pulp mill in 1990.

Coated groundwood will climb 328,000 tons during the 1989-91 period for an average rate of 2.4%/year. That exceeds the 1.6% average annual growth rate from 1979 to 1988. The major coated groundwood project is a new 220,000-tpy machine at Blandin Paper Co.'s Grand Rapids, Minn., mill. At least eight new lightweight coated paper machines are under study at U.S. mills for the early 1990s, including one new mill proposed for Millinocket, Maine, that would be built by a joint venture of Great Northern Nekoosa Corp. and MD Papierfabriken Heinrich Nicolaus GmbH of Fed. Rep. Germany.

Uncoated groundwood pa-per, which includes supercalendered paper, will add only 179,000 tpy of capacity. Average growth of 3.4%/year will be well below the 1979-88 annual growth rate of 6%. Most of the capacity expansion is related to rebuilds at Daishowa America Co.'s Port Angeles, Wash., mill.

Capacity for tissue paper will grow at a 2.7% average annual rate as a result of the installation of five new machines between 1989 and 1991. The most recent announcement is for a 70,000-tpy machine to be installed at FSC Paper Co., Alsip, Ill. Fort Howard Corp. started up new re-

GROWTH TRENDS IN U.S. PAPER AND PAPERBOARD CAPACITY[1]

(000 short tons)

Year	Total paper and board	Change (%)	Total paper	Change (%)	Total paperboard	Change (%)
1991e	88,564	3.7%	44,631	3.5%	43.933	3.8%
1990e	85,427	3.5	43,106	4.0	42,321	2.9
1989e	82,568	2.8	41,439	3.1	41,128	2.5
3-year change and average annual rate	8,249	3.3	4,432	3.5	3,817	3.1
1988e	80,315	6.0	40,199	5.7	40,116	6.2
1987	78,186	3.2	39,080	2.8	39,106	3.6
1986	75,777	2.0	38,014	1.2	37,763	2.8
1985	74,301	1.6	37,581	1.3	36,720	2.0
1984	73,098	2.8	37,106	4.0	35,992	1.5
1983	71,126	1.5	35,675	2.9	35,451	0.1
1982	70,086	2.8	34,665	2.8	35,421	2.8
1981	68,172	2.7	33,706	3.2	34,466	2.2
1980	66,368	2.7	32,659	4.7	33,709	0.8
1979	64,615	2.4	31,179	2.4	33,436	2.5
1978	63,091	1.8	30,460	2.1	32,631	1.4
10-year change and average annual rate	17,224	2.8	9,739	3.1	7,485	2.5

1. Excludes construction paper and board.
e = Estimate.
Source: American Paper Institute.

GROWTH TRENDS IN U.S. PAPERBOARD GRADES CAPACITY[1]

(000 short tons)

Year	Unbleached kraft	Change (%)	Solid bleached	Change (%)	Semi-chemical	Change (%)	Recycled	Change (%)
1991e	22,597	5.4%	4,985	3.5%	6,369	3.4%	9,983	0.8%
1990e	21,439	3.7	4,815	2.1	6,160	2.9	9,907	1.6
1989e	20,675	2.5	4,715	0.8	5,987	3.3	9,752	3.0
3-year change and average annual rate	2,423	3.9	306	2.1	573	3.2	515	1.8
1988e	20,174	8.1	4,679	2.3	5,796	4.3	9,468	5.1
1987	19,421	4.1	4,735	3.5	5,682	2.2	9,267	2.9
1986	18,662	2.9	4,576	4.7	5,557	2.7	9,008	2.4
1985	18,144	1.7	4,370	4.4	5,411	3.0	8,795	0.8
1984	17,834	1.8	4,185	1.4	5,252	2.6	8,722	0.3
1983	17,511	0.6	4,129	0.1	5,119	-1.7	8,962	0.0
1982	17,402	4.0	4,123	-0.4	5,207	4.4	8,690	1.1
1981	16,738	4.8	4,141	-0.9	4,988	0.8	8,599	-0.2
1980	15,967	2.7	4,180	-2.1	4,946	1.7	8,617	-1.6
1979	15,546	3.3	4,268	1.7	4,864	2.6	8,757	1.3
1978	15,054	1.8	4,197	4.4	4,739	1.7	8,642	-0.7
10-year change and average annual rate	5,120	3.4	482	1.5	1,057	2.3	826	1.2

1. Excludes construction board.
e = Estimate.
Source: American Paper Institute.

GROWTH TRENDS IN U.S. PAPER GRADES CAPACITY[1]

(000 short tons)

Year	Newsprint	Change (%)	Printing/ writing	Change (%)	Packaging and converting	Change (%)	Tissue	Change (%)
1991e	7,117	3.5%	25,887	4.2%	5,531	1.6%	6,096	2.5%
1990e	6,877	9.1	24,838	3.6	5,445	0.6	5,946	3.3
1989e	6,301	3.0	23,971	3.9	5,410	0.3	5,757	2.3
3-year change and average annual rate	1,001	5.2	2,225	3.9	110	0.8	320	2.7
1988e	6,116	5.4	23,064	9.9	5,394	-6.3	5,626	2.8
1987	6,006	3.5	22,077	5.2	5,492	-4.6	5,505	0.6
1986	5,804	0.3	20,980	2.5	5,758	-3.8	5,472	2.4
1985	5,788	-1.1	20,473	2.9	5,985	-1.7	5,345	1.3
1984	5,851	1.3	19,890	6.7	6,088	0.2	5,276	1.7
1983	5,774	2.1	18,633	4.6	6,078	—	5,190	1.3
1982	5,654	3.6	17,809	2.9	6,076	2.8	5,125	1.8
1981	5,457	12.8	17,302	3.0	5,913	-2.6	5,035	1.6
1980	4,836	15.2	16,798	4.6	6,072	0.3	4,954	1.7
1979	4,199	2.3	16,057	3.2	6,053	-1.5	4,870	4.9
1978	4,104	0.9	15,566	3.9	6,146	-1.5	4,644	2.2
10-year change and average annual rate	2,012	5.2	7,498	4.6	-752	-1.9	982	2.0

1. Excludes construction paper.
e = Estimate.
Source: American Paper Institute.

cycled tissue machines at its Rincon, Ga., mill in 1988 and 1989, but a fourth machine has been delayed from its original early-1990s target. James River Corp. started up a new 70,000-tpy tissue machine at Wauna, Ore., in 1988, and the company plans to install two additional machines at unspecified locations during the 1989-94 period. Kimberly-Clark Corp. will start up a new 68,000-tpy tissue mill at Jenks, Okla., in 1989 and a smaller new mill at Loudon, Tenn., in 1990.

Kraft and specialty packaging papers have declined over the long term, but capacity will rise during the 1989-91 period to 5.5 million tons. Longview Fibre Co. will install a new 110,000-tpy machine at its Longview, Wash., kraft mill, and Consolidated Papers Inc. will install a new 59,000-tpy machine at its Stevens Point, Wis., specialty papers mill.

Rebuilds fuel liner growth. Unbleached kraft paperboard will grow the fastest among paperboard grades, with annual growth of 3.9%. Linerboard capacity, constituting 92% of unbleached kraft board, will climb 2.2 million tons to 20.8 million tons. Other unbleached kraft grades will climb 250,000 tons, mostly due to Mead Corp.'s new natural kraft boxboard mill scheduled for startup in Mahrt, Ala., in late 1990.

Machine rebuilds, new high-pressure presses, and other improvements are behind the strong growth expected for kraft linerboard. Only two new linerboard machines are planned—Gaylord Container Corp., Bogalusa, La., and Un-

GROWTH TRENDS IN U.S. WOODPULP CAPACITY[1]

(000 short tons)

Year	Total pulp	Change (%)	Market pulp	Change (%)
1991e	67,754	3.2%	9,403	2.3%
1990e	65,657	3.1	9,188	2.8
1989e	63,686	1.6	8,940	0.7
3-yr change and avg. annual rate	5,078	2.6	525	1.9
1988e	62,676	2.5	8,878	4.4
1987	61,172	2.4	8,505	5.8
1986	59,750	1.9	8,039	0.6
1985	58,641	1.6	7,989	6.1
1984	57,742	2.8	7,530	1.6
1983	56,143	0.0	7,414	4.7
1982	56,125	2.2	7,079	1.5
1981	54,891	3.1	6,972	2.5
1980	53,215	3.1	6,801	7.4
1979	51,637	3.7	6,334	10.2
1978	49,788	-0.2	5,746	5.1
10-yr change and avg. annual rate	12,888	2.3	3,132	4.5

1. Excludes pulp for construction paper and board.
e = Estimate.
Source: American Paper Institute.

GROWTH TRENDS IN U.S. PULP GRADES CAPACITY[1]

(000 short tons)

Year	Dissolving and special alpha	Change (%)	Sulfite	Change (%)	Sulfate, soda, and screenings	Change (%)	Semi-chemical	Change (%)	Mechanical	Change (%)
1991e	1,402	0.0%	1,591	-0.1%	52,381	3.5%	5,072	1.5%	7,308	3.7%
1990e	1,402	0.0	1,593	0.1	50,617	2.6	4,996	2.5	7,048	6.1
1989e	1,402	0.1	1,592	0.2	49,346	1.8	4,875	2.1	6,644	3.6
3-yr change and avg. annual rate	1	0.0	2	0.0	3,885	2.6	298	2.0	893	4.4
1988e	1,401	0.9	1,589	-3.5	48,496	2.8	4,774	1.6	6,415	2.5
1987	1,389	-0.7	1,646	-3.3	47,185	2.7	4,697	1.4	6,256	3.3
1986	1,399	-3.8	1,703	-2.0	45,952	2.5	4,631	-0.4	6,058	1.6
1985	1,454	-2.2	1,738	19.9	44,835	2.5	4,650	0.5	5,964	-2.6
1984	1,487	-2.5	1,450	-18.9	43,758	2.9	4,625	3.0	6,122	5.3
1983	1,525	-5.0	1,788	0.4	42,526	0.7	4,490	-5.2	5,814	0.6
1982	1,606	0.5	1,780	-4.0	42,225	2.1	4,734	3.0	5,780	5.2
1981	1,598	0.5	1,855	-2.8	41,346	3.3	4,597	-0.1	5,494	8.4
1980	1,590	2.5	1,909	-4.7	40,044	2.8	4,601	1.1	5,070	10.9
1979	1,551	-1.4	2,004	-4.3	38,956	2.6	4,553	-0.4	4,573	-0.2
1978	1,573	-4.6	2,095	-7.0	37,968	2.6	4,572	1.3	4,580	1.7
10-yr change and avg. annual rate	-172	-1.1	-506	-2.3	10,528	2.5	202	0.5	1,835	3.5

1. Excludes pulp for construction paper and board.
e = Estimate.
Source: American Paper Institute.

ion Camp, Savannah, Ga.—although Mead's Mahrt machine will initially produce linerboard as well as boxboard. These new machines will supply only about one-third of the overall capacity growth, with the remainder coming from incremental expansion projects on existing machines.

Capacity growth for semichemical corrugating medium will expand in line with linerboard, increasing at a 3.2% annual rate from 5.8 million tons in 1988 to 6.4 million tons in 1991. Most of the additional capacity will come from machine rebuilds. Recycled corrugating medium capacity will grow at a 4.9% annual rate, increasing from 1.9 million tons to 2.1 million tons.

Other recycled paperboard grades will show little growth in capacity, although several companies have announced studies that may lead to new mill projects later in the 1990s. Bleached paperboard will rise a modest 2.1% annually, mostly due to machine improvements at Federal Paper Board Co. Inc., Augusta, Ga., and at International Paper Co., Texarkana, Texas, and Pine Bluff, Ark. In addition, Federal Paper Board will install a new 235,000-tpy machine at Augusta to produce mostly bleached bristols. Startup is targeted for 1992.

Pulp growth plans climbing. Activity is picking up strongly in the chemical pulping area after a hiatus of several years. In all, more than 100 separate expansion projects are scheduled for 1989-91, API reported. Capacity for bleached and semibleached softwood pulp grades will increase 960,000 tons by 1991, while hardwood tonnage will climb 1.36 million tons. Capacity for unbleached grades will increase by 1.6 million tons.

High market pulp prices have prompted the coming wave of pulp expansions. High prices and tight markets are incentives to producers, who need more pulp to sell, and to consumers, who want to quit buying expensive market pulp. The current crop of expansion projects is about evenly divided between the two groups.

This upswing in expansion plans has been a recent phenomenon, with many of the largest projects gaining approval in late 1988. Most of the increases will come in 1990 or later. Expansion projects announced for completion in 1990 by Weyerhaeuser Co. at Columbus, Miss.; Louisiana-Pacific Corp. at Samoa, Calif.; and Bowater Southern Paper Co. at Calhoun, Tenn., will add over 450,000 tpy to bleached kraft market pulp capacity. In 1991, Stone Container Corp.'s Port Wentworth, Ga., mill will start up a 740-tpd bleached hardwood kraft market pulp mill as part of a $335-million modernization. Also that year, Union Camp will complete a 105,000-tpy market pulp facility in its $675-million expansion program at Eastover, S.C. At Champion International's Courtland, Ala., mill, a $408-million modernization scheduled for completion in 1993 includes 250,000 tpy of new bleached kraft pulp.

In mid-1989, Parsons & Whittemore Inc. announced its plans to build a new 492,000-tpy bleached softwood kraft market pulp mill at Claiborne,

REGIONAL CAPACITY DISTRIBUTION

(000 short tons)

	1991e	1987	1980	1975
TOTAL PAPER/BOARD[1]				
New England	6,734	6,060	5,536	5,106
Mid-Atlantic	5,653	5,378	5,801	5,760
East North Central	13,659	12,408	10,440	10,110
West North Central	2,228	1,596	1,290	1,193
South Atlantic	21,420	19,187	16,455	14,396
East South Central	12,093	10,365	8,152	7,380
West South Central	13,608	11,603	9,632	8,487
Mountain & Pacific	12,819	11,588	9,364	8,423
Total U.S.[2]	88,565	78,185	66,670	60,855
TOTAL WOODPULP[1]				
New England	3,596	3,381	3,123	2,736
Mid-Atlantic	1,430	1,411	1,315	1,285
East North Central	4,108	3,908	3,188	2,906
West North Central	995	663	577	685
South Atlantic	21,191	19,290	16,902	15,220
East South Central	12,976	11,340	9,062	7,675
West South Central	12,053	10,746	9,821	8,971
Mountain & Pacific	11,120	10,433	9,228	8,861
Total U.S.[2]	67,755	61,172	53,216	48,339

Regions are as follows:
New England: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island.
Mid-Atlantic: New York, Pennsylvania, New Jersey.
East North Central: Wisconsin, Michigan, Illinois, Indiana, Ohio.
West North Central: North Dakota, South Dakota, Minnesota, Nebraska, Iowa, Kansas, Missouri.
South Atlantic: Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida.
East South Central: Kentucky, Tennessee, Mississippi, Alabama.
West South Central: Oklahoma, Arkansas, Texas, Louisiana.
Mountain/Pacific: Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Utah, Arizona, New Mexico.

[1] Excludes construction paper and board and pulp to produce these grades.

[2] 1991 total for total paper and board includes 351,000 tons from unspecified locations; 1991 pulp total includes 286,000 tons.

e = Estimate.

Source: American Paper Institute.

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR U.S.

Company	Location	Project	Grade	Capacity (tpy)
Started up in 1988				
Fort Howard	Rincon, Ga.	new machine	tissue	88,000
Georgia-Pacific	Palatka, Fla.	new machine	tissue	35,000 net
Georgia-Pacific	Zachary, La.	new machine	uncoated free-sheet	294,000
James River	Clatskanie, Ore.	new machine	tissue	70,000
Midtec Paper	Kimberly, Wis.	new machine	coated free-sheet	205,000*
Potlatch	Cloquet, Minn.	new machine	coated free-sheet	n.a.
For 1989 startup				
Atlas Paper Mills	Hialeah, Fla.	new machine	tissue	14,000
Blandin Paper	Grand Rapids, Minn.	new machine	coated groundwood	254,000*
Fort Howard	Rincon, Ga.	new machine	tissue	88,000
Fort Howard	Green Bay, Wis.	new machine	tissue	n.a.
FSC Paper	Alsip, Ill.	new mill	tissue	80,000
Hollingsworth & Vose	Hawkinsville, Ga.	new machine	specialty industrial	
Kimberly-Clark	Jenks, Okla.	new mill	tissue	68,000
Kimberly-Clark	Whiting, Wis.	new machine	cotton fiber paper	30,000
Newsprint South	Grenada, Miss.	new mill	newsprint	225,000
Ponderay Newsprint	Usk, Wash.	new mill	newsprint	198,000
Southeast Paper Mfg.	Dublin, Ga.	new machine	newsprint	210,000
For 1990 startup				
Alabama River Newsprint	Claiborne, Ala.	new mill	newsprint	243,000
Boise Cascade	International Falls, Minn.	new machine	uncoated free-sheet	300,000
Champion International	Quinnesec, Mich.	new machine	coated free-sheet	265,000
Chesapeake	Menasha, Wis.	new machine	tissue	80,000
Consolidated Papers	Stevens Point, Wis.	new machine	specialty coated	59,000
Gaylord Container	Bogalusa, La.	new machine	unbleached kraft liner	354,000
Kimberly-Clark	Loudon, Tenn.	new mill	tissue	n.a.
Longview Fibre	Longview, Wash.	new machine	kraft paper	107,000
Mead	Mahrt, Ala.	new mill	coated kraft paperboard	366,000
Mi Ho Paper	St. Joseph, Mo.	new mill	recycled fine paper	n.a.
Scott/Warren	Skowhegan, Maine	new machine	coated free-sheet	215,000
U.S. Paper Mills	Menasha, Wis.	new machine	recycled paperboard	85,000
Willamette Industries	Bennetsville, S.C.	new mill	uncoated free-sheet	200,000
For 1991 startup				
Nekoosa Papers	Ashdown, Ark.	new machine	uncoated free-sheet	325,000
Union Camp	Savannah, Ga.	new machine	unbleached kraft liner	460,000*
Union Camp	Eastover, S.C.	new machine	uncoated free-sheet	240,000
For 1992 startup				
Federal Paper Board	Augusta, Ga.	new machine	bleached bristols	235,000
International Paper	Undetermined	new machine	white papers	n.a.
Proposed projects (no startup date announced)				
Blandin Paper	Grand Rapids, Minn.	new machine	coated groundwood	220,000
Boise Cascade	Rumford, Maine	new machine	coated groundwood	n.a.
Bowater	Calhoun, Tenn.	new machine	coated groundwood	240,000
Daishowa America	Port Angeles, Wash.	new machines (2)	newsprint/groundwood	220,000
Fraser Paper	Madawaska, Maine	new machine	coated groundwood	n.a.
GNN/MD Papier	Millinocket, Maine	new mill	coated groundwood	n.a.
James River	St. Francisville, La.	new machine	coated groundwood	n.a.
Kenaf International	South Texas	new mill	newsprint	237,000
Lake Superior Paper Industries	Duluth, Minn.	new machine	uncoated groundwood	240,000
Northampton Paperboard	Northampton, Pa.	new mill	recycled linerboard	300,000
North Pacific	Longview, Wash.	new machine	uncoated groundwood	230,000
Parsons & Whittemore	Claiborne, Ala.	new mill	kraft market pulp	468,000
Smurfit Newsprint	Newberg, Ore.	new machine	newsprint	275,000
Trans-Rim	Dunkirk, N.Y.	new mill	recycled containerboard	200,000
Westvaco	Covington, Va.	new machine	bleached paperboard	300,000

n.a. = Not available.
* Replaces some existing capacity.
Source: *Pulp & Paper Project Report.*

Ala. The $700-million expansion is targeted for completion in late 1991.

These new projects join previously announced major expansions under way at Georgia-Pacific, Port Hudson, La.; Nekoosa Paper Inc., Ashdown, Ark.; Federal Paper Board, Riegelsville, N.C.; and ITT Rayonier Inc., Jesup, Ga. A $330-million expansion at Pope & Talbot Inc.'s Halsey, Ore., kraft market pulp facility will probably be completed in 1991, and WTD Industries has announced its intention to build a $420-million greenfield bleached kraft market pulp mill in Port Westward, Ore., by 1992.

The Weyerhaeuser-Columbus and Bowater-Calhoun projects will provide pulp for both internal consumption and for market sale. About 200 tpd of the 1,200-tpd Weyerhaeuser expansion will go for internal use. At Bowater, the new 900-tpd bleached kraft pulp facility will replace an aging 700-tpd semichemical kraft pulp plant, providing low-cost furnish for newsprint production as well as about 80,000 tpy of hardwood kraft pulp to sell on the open market. In a similar vein, the new newsprint mill to be built by Abitibi-Price and Parsons & Whittemore at Claiborne, Ala., will benefit from pulp supplied by P&W's adjacent Alabama River pulp mill, which plans to boost pulp capacity about 30,000 tpy.

Among integrated papermakers, the kraft paperboard sector is contributing the most to pulp expansion activity, with plans to overhaul aging facilities to control odor, reduce costs, and provide furnish for new capacity.

Union Camp is the leader in this regard, with two projects to modernize pulp facilities in support of linerboard expansions at Montgomery, Ala., and Savannah, Ga. Major programs are also under way at Federal Paper Board's Augusta, Ga., bleached paperboard and bristols mill and at Temple-Inland Inc.'s Rome, Ga., linerboard facility.

Mechanical pulping capacity, including thermomechanical pulp and chemi-thermo-mechanical pulp, will increase by 1.2 million tons during 1989-91. Mechanical pulp expansions in the U.S. are primarily integrated with new newsprint and groundwood pa-per expansions.

As part of the overall pulp expansion, market pulp capacity will grow 1.9% annually during the 1989-91 period, after increasing 5.8% in 1987 and 4.4% in 1988. Market pulp capacity will climb 525,000 tons during the following three years, raising industry capacity to 9.4 million tons in 1991.

The tight supply and high prices of market pulp have encouraged greater utilization of wastepaper at U.S. paper and paperboard mills. Consumption of wastepaper at U.S. mills is expected to reach about 23 million tons in 1991 if the industry operates at full capacity. As a result of this trend, wastepaper's share of fiber consumption will increase from 24.4% in 1987 to 25.6% in 1991.

INDEFINITELY IDLED PULP AND PAPER MILLS IN U.S.

Company	Mill	Grade
Boise Cascade	Elizabeth, La.	Kraft paper
Boise Cascade	Brownville, N.Y.	Recycled paperboard
Clevepak	Piermont, N.Y.	Recycled paperboard
Crown Paper Board	Philadelphia, Pa.	Recycled paperboard
Deerfield Specialty Papers	Monroe Bridge, Mass.	Specialty papers
Doeskin	Clayville, N.Y.	Tissue
Evers Paper	Utica, N.Y.	Recycled paperboard
Falls Tissue	Mechanic Falls, Maine	Tissue
Federal Paper Board*	Marseilles, Ill.	Recycled paperboard
Hinsdale Products	Hinsdale, N.H.	Tissue
International Paper	Bastrop, La.	Semichemical medium
International Paper	Springhill, La.	Kraft paper/board
International Paper	Reigelsville, Pa.	Recycled paperboard
Nicolet	Norristown, Pa.	Asbestos paper
Ponderosa St. Lawrence	Ogdensburg, N.Y.	Deinked market pulp
Ponte & Sons	Clifton, N.J.	Recycled paperboard
Simkins Industries	Miami, Fla.	Recycled paperboard
Skybel Tissue Mills	Greenwich, N.Y.	Tissue
Toronto Paperboard	Toronto, Ohio	Recycled paperboard
USG Industries	Oakmont, Pa.	Kraft paper
Vincennes Paper Mills	Vincennes, Ind.	Recycled paperboard
Warrensburg Board & Paper	Warrensburg, N.Y.	Corrugating medium
Whippany Paper Board	Whippany, N.J.	Recycled paperboard

* Mill has been dismantled.

Source: *1989 Lockwood-Post's Directory.*

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

	Number of paper machines shut down[1]				Number of paper mills shut down[1]			
	1971-75	1976-80	1981-85	1986-91e	1971-75	1976-80	1981-85	1986-91e
PAPER								
Newsprint	—	3	5	—	—	1	—	—
Printing/writing	51	32	38	18	8	5	4	2
Packaging/industrial converting	35	32	31	9	8	7	7	2
Tissue	6	25	30	12	4	8	13	2
PAPERBOARD								
Unbleached kraft	2	2	5	3	—	1	—	—
Solid bleached	1	2	—	2	—	1	—	—
Semichemical	3	4	7	1	1	1	2	—
Recycled	29	35	18	4	14	12	12	1
TOTAL PAPER AND BOARD[2]	127	135	134	49	35	36	38	7
Average rate/year	25	27	27	8	7	7	8	1

e = Estimate.

1. Includes machines converted to other grades.
2. Excludes construction grades.

Source: American Paper Institute

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

(000 short tpy)

	1971-75	1976-80	1981-85	1986-91e
PAPER				
Newsprint	—	231	360	—
Printing/writing	803	550	771	122
Packaging/industrial converting	290	395	821	—
Tissue	52	246	308	68
PAPERBOARD				
Unbleached kraft	128	400	742	—
Solid bleached	33	162	—	—
Semichemical	123	178	553	—
Recycled	872	1,295	644	35
TOTAL PAPER AND BOARD*	2,301	3,457	4,199	225
Average rate/year	460	691	840	38

* Excludes construction grades.
e = Estimate.

Source: American Paper Institute.

United States:

MERGERS AND ACQUISITIONS

Merger and acquisition activity in the paper industry skyrocketed during the 1980s, mirroring a trend that was evident throughout the U.S. business world. Counting just major purchases where dollar amounts are publicly available, merger and acquisition costs involving industry assets approached $25 billion for the ten-year period from 1978 to 1987. Smaller deals and those where prices were not announced easily added 5% to 10% to that total.

These investments provided strategic growth for some companies while moderating the expansion in industrywide capacity. Late in the decade, the industry seemed to take pause from its almost relentless buying-and-selling spree. Most companies had already acquired what they needed and were working off debt loads. Many that were still spending were using their funds for smaller acquisitions such as converting or marketing companies—especially emphasizing global competitive position.

Because of the industry's need to downsize and consolidate during the early 1980s, acquisitions provided a viable way for companies to position themselves at a fraction of the cost of building new facilities. According to First Boston analysts, the average value of transactions in the mid-1980s was about $600 million, with 20 deals in the $100-million area. Through 1987, six multi-billion-dollar deals were made for paper companies, beginning with Champion International Corp.'s buyout of St. Regis Corp. in 1984 for $1.84 billion. Another three deals were made for companies peripheral to the industry. Then, in mid-1988, a $3.962-billion leveraged buyout (LBO) of Fort Howard Corp. set a new high for industry acquisitions. It appeared that this deal might be the last big bang for the decade, until Georgia-Pacific Corp. launched a $3.18-billion bid to buy out Great Northern Nekoosa Corp. in October 1989.

With the G-P bid capping off the decade, the 1980s will be remembered for mergers that clearly and collectively left their mark on the structure of the industry. Fourteen of 32 Fortune 500 companies in the forest-products industry made large purchases during the decade. Three in this group—Bowater Inc., Temple-Inland Inc., and Georgia Kraft Co.—are recent spin-offs from larger companies. Between 1983 and 1987, nine of the top industry producers (those with capacity for 1,000 tpd or more) disappeared—all of them swallowed up by other companies. This group included Container Corp. of America, Continental Forest Industries, Crown Zellerbach Corp., Hammermill Paper Co., Jacksonville Kraft Co., Owens-Illinois Inc.'s Forest Products Group, Publishers Paper Co., St. Regis, and Southwest Forest Industries Inc.

Among the top ten producers, only Scott Paper Co. has not made a major purchase in recent years. Stone Container Corp., James River Corp., and Jefferson Smurfit Corp. have been the most aggressive. Other companies that have grown substantially through purchases include Champion, International Paper Co., Great Northern Nekoosa, Georgia-Pacific, and Federal Paper Board Co. Inc.

Acquisitions have also accelerated the industry's long-term trend toward higher concentration. For example, one-third or more of the linerboard industry's capacity changed hands in the mid-1980s. In 1988, the top eight companies held 65% of kraft linerboard capacity. Stone Container alone holds a 14% market share of capacity—almost twice that of the next largest producer. However, if Georgia Pacific purchases Great Northern Nekoosa, their combined linerboard assets will take the lead from Stone Container by a few tons.

Overall, concentration among the top 15 paper and paperboard producers grew from 53% in 1983 to nearly 70% in 1988. Why have the mid-1980s been such boom years for mergers and acquisitions? One important factor is the threat of takeover, which has forced company managements to concentrate on shareholder value as never before. Related to this is the trend toward de-conglomeration, in which diversified companies sell off assets outside their main business lines.

Another factor is the build-vs-buy equation. In the 1980s, it was usually much cheaper to buy an existing mill than to build one. First Boston estimated that recent major transactions were for just 30% to 40% of replacement value. For example, Georgia-Pacific paid an estimated 41% of replacement cost for Brunswick Pulp & Paper Co. in late 1988.

The takeover threat. Three factors helped make the takeover threat real for the paper industry: undervalued companies ripe for the picking, the ready availability of funds to make purchases, and a lax antitrust environment that offered few obstacles to dealmaking.

Corporate raiders have been attracted to the paper industry by its undervalued assets, and they have been drawn especially to diversified companies that can be broken up and sold in pieces. The paper industry is a capital-intensive, cyclical business that usually offers below-average returns to investors.

What made the takeover threat so real was the ready availability of funds, even for multi-billion dollar deals. Whole new financial industries sprang up around the LBO and junk bonds, and more traditional bank loans and equity financing opportunities also grew tremendously. Sheer size, which used to protect companies from unwanted suitors, was no longer a good defense. This situation forced companies to take a hard look at their operations, to concentrate their assets in the businesses they know best, and to purchase complementary businesses that could boost returns.

Disarray in the junk-bond market in 1989 put financial buyers at a disadvantage in the takeover game. Instead, consolidation seemed to be the new wave in takeovers, with paper companies themselves taking the initiative. Following Georgia-Pacific's bid for Great Northern Nekoosa in late 1989—the first hostile bid ever among the industry's major players—industry analysts speculated that paper companies would become more aggressive with unsolicited bids, possibly involving companies such as Mead Corp., Union Camp Corp., and Federal Paper Board.

Favorable business climate. The merger boom has also been given a boost from the lax antitrust environment of the Reagan-Bush years. In the highly concentrated tissue sector, James River became a strong contender for number-one position through a series of acquisitions beginning in 1982. Stone Container achieved its number-one status in kraft linerboard during the same period, but Georgia-Pacific threatened to snatch the lead with its proposed takeover of Great Northern Nekoosa. International Paper was able to purchase competitor Hammermill Paper in 1986, adding to its already commanding presence in white papers.

The tax code also favored takeovers during most of the 1980s. Before 1987, low capital gains rates and other incentives made acquisitions attractive for raiders who wanted to sell off assets quickly. Merger activity grew to a frenzy in 1986 as companies struggled to complete deals before the Tax Reform Act took effect. A similar situation developed in 1987, with companies trying to beat tax legislation designed to close loopholes in the 1986 bill. The tax structure in 1988 made it less attractive to spin off assets; however, reforms in the capital gains tax proposed by President George Bush in 1989 could launch a new divestiture trend and set off a string of acquisitions.

The combination of excellent operating conditions, readily available funds, and low stock prices kept paper industry acquisitions attractive in 1988, but funding was getting decidedly tight in 1989, causing many deals to fall through. In addition, the backlash against corporate raiders has led more purchasers to seek a good business fit, rather than assets that can be broken up and sold off quickly.

The October 1987 stock market crash served to lower prices for paper company stocks and to attract huge amounts of cash to LBO funds—a combination that led to the $3.962-billion LBO of Fort Howard by company management and a Morgan Stanley fund. Rumors circulated during 1988 and 1989 about similar buyout attempts, but none materialized. Mentioned as possible targets were such major companies as Kimberly-Clark Corp., Bowater, and Louisiana-Pacific Corp. However, Great Northern Nekoosa was the only takeover actually attempted after the Fort Howard deal.

While takeover prices appeared to be on the rise in 1988, fund shortages that foiled many takeover attempts may have actually reduced prices. In 1987, Great Northern Nekoosa paid a price near replacement cost for Owens-Illinois' Forest Products Group, leading many observers to suggest that takeover prices were on the rise. That same year, however, Mead and Scott were forced to withdraw a proposal to sell Brunswick Pulp & Paper when they could not find a buyer at the asking price. In June 1988, Brunswick was sold to Georgia-Pacific for $665 million—an estimated 41% of replacement cost. Since then, at least two companies have made purchases equaling 50% or more of estimated replacement cost: Daishowa Paper Co. Ltd.'s $75-million acquisition of James River's Port Angeles, Wash., mill, and Gaylord Container Corp.'s $138-million purchase of Louisiana-Pacific's Antioch, Calif., mill.

HOSTILE TAKEOVER ATTEMPTS

Corporate raiders are less of a threat now than they were a few years ago. Most companies have taken steps to prevent hostile takeovers, such as selling off assets that might attract raiders, restructuring debt, and staggering directorships. USG Industries successfully fought off a hostile takeover attempt by Desert Partners in 1988 by pushing through its own recapitalization plan, for example.

Late in 1989, a $21-billion bid for B.A.T. Industries plc was launched by Sir James Goldsmith, one of the biggest corporate raiders and no stranger to the paper industry. The bid failed when the company decided to divest its paper, retail, and financial businesses. As a result, Wiggins Teape Group Ltd. and Appleton Papers Inc. were combined in a new, publicly-held holding company run by management from the two firms.

Even if Goldsmith had bought B.A.T. and divested certain groups—which he indicated was his intention—he would not have gained as much as he would have prior to U.S. tax law changes. The 1986 and 1987 tax reforms made it costly for raiders to sell off assets quickly. In addition, raiders have suffered adverse publicity from insider-trading scandals, and many states have passed laws limiting hostile

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Georgia-Pacific Corp.	Great Northern Nekoosa Corp.	$3,180	Pending
Jujo Paper Co.	Doubled stake in North Pacific Paper Co. to 20%	n.a.	1989
Arcadia Partners L.P.	Ivex Corp.'s three specialty papers mills	n.a.	1989
Warrior River Paper Co.	Howard Paper Mills Inc.'s two printing/writing paper mills	n.a.	1989
Newark Group	Gold Bond Building Products' recycled board mill	n.a.	1989
Mosinee Paper Corp.	Procter & Gamble Corp.'s Cheboygan, Mich., tissue mill	n.a.	1989
Kapaco Group	Watervliet Paper Co.'s Watervliet, Mich., specialty papers mill	n.a.	1989
Investor Group	APL Corp.'s tissue business	50	1989
Giant Group Ltd.	Garden State Paper Co.'s Pomona, Calif., newsprint mill	56	1989
Preco Corp.	E.B. Eddy's Brewer, Maine, fine paper mill	n.a.	1988
Fairfield Paper Co.	Gaylord Container Corp.'s Baltimore, Ohio, containerboard mill	17	1988
FH Acquisition	Management's leveraged buyout of Fort Howard Paper Co.	3,962	1988
James River Corp.	23% of Diamond Occidental's common stock	25	1988
Settsu Corp.	9.6% stake in USG Corp.	35.5	1988
Caraustar Industries Inc.	USG Corp.'s Camden, N.J., gypsum linerboard mill	n.a.	1988
Valley Converting Co.	Toronto Paperboard Corp.'s recycled board mill	n.a.	1988
Newark Group	Federal Paper Board Co.'s Los Angeles, Calif., recycled board mill	n.a.	1988
Georgia-Pacific Corp.	Brunswick Pulp & Paper Co.	665	1988
Daishowa America Co. Ltd.	Port Angeles, Wash., groundwood paper mill from James River	75	1988
Gaylord Container Corp.	Fibreboard Corp. containerboard assets from Louisiana-Pacific Corp.	156	1988
Kapaco Group	Pentair Inc.'s Detroit, Mich., specialty papers mill	n.a.	1988
Rock-Tenn Co.	Mead Corp.'s recycled paperboard businesses	65	1988
E.B. Eddy Forest Products Ltd.	Port Huron Paper Corp. from Pentair	n.a.	1987
P.H. Glatfelter Co.	Ecusta Corp.	219	1987
Great Northern Nekoosa Corp.	Forest Products Group of Owens-Illinois Inc.	1,170	1987
James River Corp.	Dunn Paper Co. from Dennison Manufacturing	n.a.	1987
Mead Corp.	Georgia Kraft Co. mill in Phenix City, Ala.; part of reorganization and termination of joint venture with Temple-Inland	n.a.	1987
Pope & Talbot Inc.	Ransom, Pa., tissue mill from Potlatch	27	1987
Pratt Holdings Pty Ltd.	Georgia Kraft Co. linerboard mill and related assets in Macon, Ga.	272	1987
Simkins Industries Inc.	Deerfield Specialty Papers from Reed Holdings Inc.	n.a.	1987
Simpson Paper Co.	Pasadena, Texas, free-sheet paper mill of Champion International Corp.	90	1987
Simpson Paper Co.	Plainwell Paper Co. from Chesapeake Corp.	n.a.	1987
Smorgon Consolidated Industries Pty Ltd.	FSC Paper Corp. from Media General and Interstate Holdings	n.a.	1987
Stone Container Corp.	Southwest Forest Industries	760	1987
Stora Kopparberg Group	40% of Mohawk Paper Mills	24	1987
Temple-Inland Inc.	Owens-Illinois' Orange, Texas, linerboard mill	228	1986
Settsu Corp.	21% of Caraustar Industries Inc.	n.a.	1986
Boise Cascade Corp.	Jackson, Ala., mill of Allied Paper Inc.	150	1986
China National Packaging Corp.	Morris Paper Board mill in Paterson, N.J.	n.a.	1986
GC Acquisition Corp.	Gaylord Container, spun off during James River's acquisition of Crown Zellerbach	260	1986
[illegible]on Trust plc	Allied Paper Inc. from SCM Corp.	n.a.	1986
International Paper Co.	Hammermill Paper Co.	1,441	1986
JFC-MS Holdings Inc.	Container Corp. of America from Mobil Corp.	1,139	1986
James River Corp.	Crown Zellerbach Corp. pulp and paper operations	1,428	1986
James River Corp.	Premoid Group from Preco Corp.	n.a.	1986
Rand-Whitney Packaging Corp.	Montville, Conn., boxboard mill from Robertson Paper Box	n.a.	1986
Seminole Kraft Corp.	Jacksonville Kraft Paper Co.	112	1986
Jefferson Smurfit Corp.	80% of Publishers Paper Co. from Times Mirror Inc.; included two newsprint mills	132	1986
Stone Container Corp.	Most of the packaging operations of Champion International	426	1986
Temple-Inland Inc.	Linerboard mill at Orange, Texas, from Owens-Illinois	228	1986
Texcrom Paper Corp.	Chambersburg, Pa., tissue mill from United Paper Mills	n.a.	1986

continued

takeovers. Georgia-Pacific late in 1989 was challenging such a law in Maine as it attempted to take over Great Northern Nekoosa.

In mid-1989, Bowater was rumored to be the target of a corporate raider, and Abitibi-Price Inc. and Stone Container were two of the suspected purchasers. These rumors were never confirmed, however. Mead was another suspected takeover target in 1989. The previous year, WTD Industries Inc. was rumored to be buying out Longview Fibre Co., and stock prices for both companies were affected. The rumors persisted into 1989, but were never confirmed.

In the early and mid-1980s, raiders made a lot of money toppling U.S. paper companies, whether through successful buyouts or sale of their shares to a higher bidder. Hostile takeover attempts have come almost exclusively from raiders outside the pulp and paper industry. While aggressive companies like James River and Stone Container have been quick to buy the assets of acquired companies, they have not initiated hostile bids themselves. This trend may have changed with Georgia-Pacific's unsolicited bid for Great Northern Nekoosa.

Earlier consolidations within the paper industry occurred

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS (continued)

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Mid-America Packaging Inc.	Weyerhaeuser Co.'s Pine Bluff, Ark., containerboard mill	$28	1985
Federal Paper Board Co.	Continental Group's Augusta, Ga., bleached board mill	305	1985
Carlyle Investments	Hennepin Paper Co. from Champion International, and Pejepscot Paper Co. from Hearst Corp.	n.a.	1985
Chesapeake Corp.	Wisconsin Tissue Mills and Plainwell Paper from Philip Morris Inc.	210	1985
Ecusta Corp.	Purchased in leveraged buyout from Olin Corp.	130	1985
Hammermill Paper Co.	Nicolet Paper Co. from Philip Morris Inc.	n.a.	1985
International Paper Co.	Durham Mills Inc.'s recycled paperboard mill at Riegelsville, Pa.	n.a.	1985
Lyons Falls Pulp & Paper Inc.	Lyons Falls, N.Y., mill of Georgia-Pacific	n.a.	1985
Petratex Paper Co. Inc.	Specialty kraft paper mill of Bemis Co. at Peoria, Ill.	n.a.	1985
Simpson Paper Co.	Tacoma, Wash., kraft paper mill of Champion International	27	1985
Trident Associates	Two recycled paperboard mills and six folding carton plants from Champion International	n.a.	1985
Appleton Papers Inc.	Glatfelter's West Carrollton, Ohio, mill	83	1984
Boise Cascade Corp.	Sonat's 50% interest in Boise Southern	195	1984
Bowater Inc.	Bowater Corp.'s North American assets	123	1984
Caraustar Industries Inc.	Three Container Corp. of America recycled paperboard mills	n.a.	1984
Champion International Corp.	St. Regis Corp.	2,538	1984
Georgia-Pacific Corp.	Monticello, Miss., linerboard mill and related assets from St. Regis	375	1984
Peter Kiewit Sons	Continental Group Inc.	2,785	1984
Stora Kopparberg Group	Newton Falls Paper Mill	n.a.	1984
Temple-Inland Inc.	Temple-Eastex and Inland Container spun off by Time Inc.	n.a.	1984
Boise Cascade Corp.	Saxon's Missisquoi specialty paperboard mill	n.a.	1983
Haindl Paper Co.	Crown Zellerbach's Port Townsend, Wash., unbleached kraft paper mill	n.a.	1983
Jacksonville Paper Co.	St. Regis kraft paper mill	n.a.	1983
James River Corp.	American Can's Marathon, Ont., pulp mill	n.a.	1983
James River Corp.	Diamond International's pulp and papermaking assets	171	1983
Mosinee Paper Corp.	Sorg Paper Co.	18	1983
Pope & Talbot Inc.	American Can's 50% interest in Halsey, Ore., pulp mill	14	1983
Republic Gypsum Co.	Two PCA recycled boxboard mills	n.a.	1983
Stone Container Corp.	Major portion of Continental Forest's Brown System	510	1983
Technographics Inc.	Litton Industries, including Fitchburg Paper	70	1983
James River Corp.	Most of the assets of American Can Co.	446	1982
Jefferson Smurfit Ltd.	Diamond International Corp.'s paperboard, converting, and printing businesses	80	1982
Sir James Goldsmith	Acquired Diamond International Corp.	455	1982
Jefferson Smurfit Group Ltd.	Alton Box Board Co.	n.a.	1981
James River Corp.	Brown Co.	172	1980
Johns-Manville Corp.	Olinkraft Inc.	n.a.	1979

n.a. = Not available.

after a company had already taken action to divest assets. In 1984, Jefferson Smurfit purchased a stake in Southwest Forest Industries after a management-led LBO of SFI failed, but merger talks broke down quickly and Smurfit later agreed not to purchase SFI stock for ten years. In early 1986, SFI had to fend off another takeover attempt, this time from a group of Oklahoma oil and gas investors. SFI was finally purchased in 1987 in a friendly merger with Stone Container worth $760 million.

Goldsmith heads list of raiders. Sir James Goldsmith, the British financier who pursued B.A.T. Industries in late 1989, has been the most aggressive suitor of U.S. paper companies, making unsolicited offers for Diamond International Corp., Continental Group Inc., St. Regis, and Crown Zellerbach earlier in the decade. All four companies lost their independence—two to Goldsmith and two to "white knight" purchasers.

Goldsmith's strategy was to seek out undervalued companies with assets that could be sold off easily as independent units. He completed the acquisition of Diamond International in 1982, after buying an initial 5.6% stake in late 1979 and accumulating stock gradually. Total purchase price over the three-year period was about $660 million. Goldsmith then began selling off Diamond's assets one division at a time, grossing roughly $850 million from the sales by 1983. Diamond's paperboard, converting, and printing businesses were sold to Jefferson Smurfit for $80 million in 1982. In 1983, James River bought the company's papermaking assets for $170 million.

Goldsmith's next industry target was Continental Group, an insurance, energy, and packaging company and the largest U.S. producer of bleached paperboard. After purchasing a 1% stake in Continental for about $15 million, Goldsmith offered $50/share for the remainder of the company—or about $2.42 billion. Continental's management rejected the offer, and soon afterward agreed to a merger with a company owned 80% by Peter Kiewit Sons and 20% by financier David Murdock's Murdock Investment Corp. That deal was worth $58.50/share or about $2.79 billion. In order to finance the acquisition, Kiewit-Murdock sold Continental's bleached paperboard mill at Augusta, Ga., and related assets to Federal Paper Board in early 1985 for $305 million.

Fight for St. Regis. St. Regis suffered at the hands of raiders, including Goldsmith, for most of 1984. Between February and September, the company fought off two unsolicited takeover attempts, sold a large chunk of its containerboard assets to reduce its vulnerability, agreed to buy an insurance company for the same reason, and finally agreed to be acquired by white knight Champion International.

Following the same pattern as the Diamond takeover, an investor group led by Goldsmith bought an 8.6% stake in St. Regis in February. The group intended to gradually increase its stake and eventually take over the company, but St. Regis bought back its shares from the group in March, paying a substantial premium over its then-current stock price—a defensive payoff known as "greenmail."

In May, St. Regis sold its Monticello, Miss., linerboard mill and related assets to Georgia-Pacific for $342.5 million. While a takeover defense was probably not its primary reason—St. Regis had been unhappy with its containerboard operations—the sale did serve to make the company less attractive to unwanted suitors. G-P also became a friendly shareholder through the deal, agreeing to buy an 8.5% stake in St. Regis as part of the transaction.

Proceeds from the sale also improved St. Regis's ability to make acquisitions of its own, and in June the company agreed to buy insurer Colonial Penn Group Inc. for $590 million. Like G-P, Colonial Penn became a friendly St. Regis shareholder in the preliminary transaction; its stake amounted to 3.5%.

Less than a month later, however, St. Regis was targeted for takeover by Australian publisher Rupert Murdoch, who purchased a 5.6% stake in the company in July. Murdoch made a $52/share offer for the rest of St. Regis later that month, threatening an unfriendly and less generous tender offer if he was denied. Murdoch also demanded that the Colonial Penn deal be called off. St. Regis's board rejected the Australian's offer, and it blocked a takeover attempt by agreeing in early August to a friendly merger with Champion International in a transaction for stock and cash valued at $2.538 billion. The merger was completed late in 1984.

Champion began almost immediately to sell off pieces of St. Regis in order to pay for the purchase and to better integrate the two companies' operations. It first sold the Tacoma, Wash., kraft pulp and paper mill to Simpson Paper Co. The largest transaction, not completed until early 1986, sent most of the company's packaging operations to Stone Container in a deal worth $457 million. Other assets sold off included Hennepin Paper Co., two recycled paperboard mills and related folding carton plants in the Midwest, and the envelope division. In January 1988, Champion transferred the Canadian operations of St. Regis—including a market pulp mill at Hinton, Alta.—to subsidiary Weldwood of Canada Ltd. in a deal worth $274 million.

Takeover defenses. Not surprisingly, companies scrambled in 1984 to develop defensive measures that discourage unwanted takeover attempts. Some of these defenses make a takeover more difficult by concentrating shares in the hands of friendly holders, by staggering directors' terms, and by negotiating standstill agreements. Others focus on making a company too expensive (e.g., the preemptive sale of assets that would be sold off by a raider to finance a takeover). A similar defense involves making a large acquisition to boost the targeted company's purchase price, as St. Regis tried to do with Colonial Penn.

One novel approach developed in 1984 is the "poison pill," which gives special purchase rights to shareholders in the event of a hostile takeover attempt. These rights generally allow the holder to purchase shares at a steep discount once a certain threshold level of ownership—usually 20% to 30%—is surpassed by a hostile buyer. Crown Zellerbach and Owens-Illinois were the first in the paper industry to adopt poison pills, followed by Boise Cascade Corp., Bowater, Great Northern Nekoosa, International Paper, Southwest Forest Industries, and Union Camp Corp.

Crown Zellerbach taken over. A poison pill and major restructuring were not enough to save Crown Zellerbach from a determined takeover attempt in 1985 by Sir James

Goldsmith. The British financier, operating through three affiliated companies, began his attack by purchasing an 8.6% stake in CZ in March 1985 for $78.3 million. In April, he made a $42.50/share tender offer for the company, worth $807.5 million. The company rejected that bid as too low, saying it would consider a $60/share offer from Goldsmith or any other source. CZ also announced a major restructuring to separate the company's timberlands and packaging operations from its other businesses.

That same month, a white-knight agreement with Mead fell through, but Goldsmith withdrew his tender offer because of CZ's restructuring plan. As CZ's largest shareholder, Goldsmith was elected to the board of directors in May, and he spent the early summer accumulating more shares and fighting management's restructuring plan. Goldsmith's stake jumped from 19.6% at the beginning of May to 26% by early July, thus activating CZ's poison pill. Goldsmith boosted his stake to 45% by mid-month, and finally won control at month's end. The poison pill proved an empty threat because a merger never took place and because a 50% ownership threshold was never reached.

Crown Zellerbach's assets were split up over the next year into four parts. Goldsmith retained the company's timberlands and wood-products businesses. James River purchased most of CZ's papermaking operations in a stock swap valued at about $1.428 billion. With its purchase,

FOREIGN OWNERSHIP OF U.S. PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Alaska Pulp Corp.	100.0%	Alaska Pulp Co., Japan	Market pulp mill, Sitka, Alaska
Allied Paper Products	100.0	Hanson Industries, U.S. subsidiary of Hanson Trust, U.K.	Paper mill, Kalamazoo, Mich.
American Fibrit	100.0	Deutsch Fibrit, Fed. Rep. Germany	Molded pulp products mill, Battle Creek, Mich.
Appleton Papers	100.0	Batus, U.S. subsidiary of B.A.T. Industries, U.K.	Pulp/paper mills, West Carrollton, Ohio; Roaring Springs, Pa.; Combined Locks, Wis.
Alabama River Newsprint	50.0	Abitibi-Price Inc., Canada	Newsprint mill, Claiborne, Ala.
Augusta Newsprint Co.	50.0	Abitibi-Price Inc., Canada	Newsprint mill, Augusta, Ga.
Caraustar Industries	21.5	Settsu, Japan	Eight paperboard mills in South and Midwest
Cascades industries	100.0	Cascades Inc., Canada	Tissue/toweling mill, Rockingham, N.C.
Cascades Niagara Falls	100.0	Cascades Inc., Canada	Recycled corrugating medium mill, Niagara Falls, N.Y.
Chin-Am, Morris Paperboard	100.0	National Packaging, People's Rep. China	Paperboard mill, Paterson, N.J.
Container Corp. of America	50.0	Jefferson Smurfit, U.S. subsidiary of Jefferson Smurfit Group, Ireland	Nine pulp/paperboard mills
Daishowa America	100.0	Daishowa International, U.S. subsidiary of Daishowa Paper Mfg., Japan	Paper mill, Port Angeles, Wash.
E.B. Eddy Paper Inc.	100.0	E.B. Eddy Forest Products Ltd., Canada	Lightweight coated paper mill, Port Huron, Mich.
Eastern Fine Paper	100.0	E.B. Eddy Forest Products Ltd., Canada	Fine paper mill, Brewer, Maine
FSC Paper	100.0	Smorgon Consolidated Industries, Australia	Deinked pulp/newsprint mill, Alsip, Ill.
Groveton Paper Board	69.0	SPB Canada, Canada	Paperboard mill, Groveton, N.H.
Keyes Fibre	100.0	Royal Packaging Industries, Van Leer, Netherlands	Six molded pulp products mills
Leaf River Forest Products	5.0	Kymmene Stromberg, Finland	Market pulp mill, New Augusta, Miss.
MacMillan Bloedel Inc.	100.0	MacMillan Bloedel Ltd., Canada	Containerboard mill, Pine Hill, Ala.
Macon Kraft	100.0	Pratt Holdings, Australia	Linerboard mill, Macon, Ga.
Madison Paper	60.0	Myllykoski, Finland	Pulp/paper mill, Madison, Wis.
Mohawk Paper Mills	40.0	Stora Group, Sweden	Paper mills, Cohoes and Waterford, N.Y.
Newton Falls Paper Mill	100.0	Stora Group, Sweden	Paper mill, Newton Falls, N.Y.
North Pacific Paper	20.0	Jujo Paper, Japan	Pulp/newsprint mill, Longview, Wash.
Ponderay Newsprint Co.	40.0	Lake Superior Forest Products Inc., subsidiary of Canadian Pacific Forest Products Ltd., Canada	Newsprint mill, Usk, Wash.
Portals Inc.	100.0	Portals Ltd., U.K.	Paper mill, Hawkinsville, Ga.
Port Townsend Paper	100.0	Haindl Papier, Fed. Rep. Germany	Pulp/paper/paperboard mill, Port Townsend, Wash.
Schoeller Technical Papers	100.0	Felix Schoeller Jr., Fed. Rep. Germany	Paper mill, Pulaski, N.Y.
Jefferson Smurfit Corp.	78.0	Jefferson Smurfit Group, Ireland	Eleven pulp/paper/paperboard mills[1]

[1] Not including Container Corp. of America mills.

James River became one of the five largest paper companies in the U.S. CZ's container division was spun off as Gaylord Container Corp. and purchased by an investor group for $260 million. Finally, CZ's paper distribution business was sold by James River to Mead for $260 million cash, making Mead the largest integrated distributor of paper in the U.S.

Later in 1985, yet another San Francisco, Calif.-based company was targeted. The raiders were the Belzberg brothers of Vancouver, B.C., who offered $45/share—or about $693 million—for Potlatch Corp. in November 1985. That same month, however, the company bought back its shares from the Belzbergs, who agreed to forego any efforts to take over the company for five years. The $46.7 million buyback, at $43/share, was called greenmail by some observers, but the company said it was part of a broader stock repurchase program that was available to all shareholders.

In July 1986, California investor Paul Bilzerian initiated a hostile takeover bid for Hammermill Paper. The company rejected the $52/share offer—worth $900 million—as inadequate, and it began discussions with other companies about a merger. Bilzerian raised his offer to $57/share, but International Paper put in a higher bid of $64.50/share—worth $1.441 billion—and won control of the company. With its 19% stake, Bilzerian's group collected some $60 million in IP's tender offer. Hammermill has maintained its identity more than most takeover victims. No assets have been sold off, and IP operates it as a separate division.

RESTRUCTURING THE INDUSTRY

During the back-to-back recessions of 1980 and 1982, several major diversified companies decided to divest their paper industry assets and to invest their money elsewhere. This trend continued into the second half of the decade.

In 1980, Gulf + Western Industries sold its controlling interest in Brown Co. to James River and Pope & Talbot Inc. James River got most of Brown's pulp and paper operations and some timberland, and P&T received two recycled tissue mills in Wisconsin. ITT Corp. in 1980 sold its two British Columbian pulp mills and related forest-products operations to Western Forest Products Ltd. ITT put its four U.S. pulp mills and related timberlands on the block, but it could not find a buyer at the reported $3-billion asking price.

In 1982, American Can Co. sold its Dixie/Northern tissue and bleached board operations as well as some timberland to James River. The following year, the company completed its pullout from the industry by selling its Marathon, Ont., pulp mill to James River and by selling its 50% interest in a Halsey, Ore., pulp mill to Pope & Talbot.

The pace, if not the scale, of divestitures picked up as the recession waned in 1983. Several companies shed their paper-industry assets in favor of less cyclical investments.

In May 1983, Time Inc. announced the spin-off of its Inland Container Corp. and Temple-Eastex Inc. units into a new company, Temple-Inland Inc., so that Time could increase investments in its video and publishing units. In June, Litton Industries Inc. moved to concentrate on its electronics businesses, selling the major part of its Paper, Printing & Forms Group to Technographics Inc. in an LBO worth about $70 million. Also in June, Clevepak Corp. sold its partition mill division and other packaging assets to Rock-Tenn Co. for about $40 million. In August, Phillips Petroleum Co. sold its H.P. Sith Paper Co. unit to James River for $34.5 million.

Efforts to take advantage of better conditions in the paper industry extended into 1984. Sonat Inc. sold its 50% interest in Boise Southern Co. to partner Boise Cascade for $217 million. The U.K.'s Bowater Corp. spun off its North American operations in a tax-free "demerger" that automatically created the largest U.S.-based newsprint producer, Bowater Inc.

In order to expand and to diversify its product lines, Chesapeake Corp. purchased Wisconsin Tissue Mills and Plainwell Paper Co. from Philip Morris Inc. in April 1985 for $214 million. A month later, Philip Morris exited the industry with the sale of Nicolet Paper Co. to Hammermill.

In May 1986, Boise Cascade expanded into the southeastern white-papers market with the $150-million purchase of Allied Paper's bleached kraft pulp and paper mill in Jackson, Ala. Boise acquired the mill from Hanson Trust plc, which had picked up Allied in a hostile takeover of SCM Corp. earlier that year. Also in 1986, Times Mirror Co. sold 80% of Publishers Paper Co. to Jefferson Smurfit for $150 million. The deal, Smurfit's first foray into the newsprint sector, included a long-term supply contract for newsprint for Times Mirror publications.

Smurfit was also involved in another big divestiture of 1986: Mobil Corp.'s sale of Container Corp. of America for $1.16 billion to a partnership between Smurfit and a Morgan Stanley investor group. Mobil had owned CCA since 1976.

In 1989, Jefferson Smurfit Group plc of Ireland and the Morgan Stanley Leveraged Equity Fund II (MSLEF—the investment affiliate of Morgan Stanley & Co. Inc.) jointly announced a proposal to acquire at $38/share all of the outstanding shares of Jefferson Smurfit Corp. not currently owned by the Smurfit Group. This was part of a larger scheme by which the Smurfit Group intended to divest a large part of its U.S. holdings, including its 50% share of Container Corp. of America, to a new company, SIBV-MS Holdings Inc., which would be jointly owned by the Smurfit Group and MSLEF.

Owens-Illinois began the process of exiting from the industry in early 1986, when it agreed to sell its Orange, Texas, linerboard mill and related assets to Temple-Inland for $228 million. After an LBO by Kohlberg Kravis Roberts Inc. in early 1987, O-I's Forest Products Group was sold to Great Northern Nekoosa in July. Intense bidding for these prime containerboard assets, during a period of excellent market conditions, helped drive up the price to $1.17 billion—near replacement cost.

Repositioning businesses. Companies inside the industry have also moved to streamline their operations and to rethink their business strategies. The result has been a steady stream of sales and acquisitions, as companies shed operations that no longer fit their plans, and expand into new areas.

In a major restructuring to focus on its core businesses, Mead ended joint ventures with Temple-Inland and Scott Paper in 1987 and 1988, and it also sold its recycled paperboard business to Rock-Tenn Co. In the dissolution of the joint ventures, the Georgia Kraft Co. linerboard mill at Macon, Ga., was sold to Pratt Holdings Pty Ltd. of Australia for an undisclosed amount, and Brunswick Pulp & Paper was sold to Georgia-Pacific. The Brunswick mill more than doubled G-P's bleached board capacity, and it doubled the company's export capacity for market pulp. If its bid for Great Northern Nekoosa is successful, G-P will become the largest U.S. forest products company, moving up from third position (based on sales) in 1988.

Louisiana-Pacific took steps in 1987 to distance itself from asbestos liability and to leave the containerboard sector with the spin-off of Fibreboard Corp. The move concentrated L-P's assets in market pulp and forest products. Fibreboard's containerboard division was sold to Gaylord Container for $156 million.

In a move to concentrate on printing/writing papers, Pentair Inc. sold its Port Huron, Mich., specialty papers mill to E.B. Eddy Forest Products Ltd. of Canada in August 1987. Pentair's other specialty papers mill in Detroit, Mich., was sold in December to Kapaco Group. In early 1989, Eddy sold its Eastern Fine Paper Inc. affiliate in Brewer, Maine, for an undisclosed amount to Preco Corp. (which owns Lincoln Pulp & Paper Co. Inc.).

Aggressive expansion. Some firms have expanded rapidly by buying assets from companies that want to either leave the industry or streamline their businesses. James River, which began as a one-mill operation in 1969, is the best example of this strategy. It climbed into the top five by purchasing assets divested by companies leaving the industry or sold off after takeovers. After the Brown deal with Gulf + Western in 1980, James River more than doubled its size with the 1982 purchase of American Can's paper-industry assets for $446 million. This further integrated James River into pulp production, and made it a major national producer of tissue and folding cartons.

In 1983, the company paid $172 million for Diamond International's pulp and papermaking assets, adding to its white papers capacity and extending its tissue and towel business in the Northeast. In 1986, James River moved into the top five among paper companies with the purchase of Crown Zellerbach's paper operations for $1.43 billion.

The company has also moved aggressively to expand in the international market, particularly in Europe. In 1987, James River purchased 50% of the Kaysersberg Div. of French papermaker Beghin-Say for $243 million. Kaysersberg's tissue and nonwovens business will be used as a platform for expansion in Europe. This purchase was followed in 1989 by the $77-million acquisition of the tissue operations of Buhrmann-Tetterode N.V. of the Netherlands.

Stone Container more than doubled its capacity in 1983 with the purchase of Continental Forest Industries' Brown System operations for $510 million. In 1986, Stone purchased most of the packaging operations of Champion International for $457 million after Champion's merger with St. Regis. The deal made Stone the world's largest producer of unbleached kraft packaging products. The company added to its containerboard capacity with the purchase and reactivation of the former Jacksonville Kraft Co. mill at Jacksonville, Fla., in a partnership called Seminole Kraft Corp. Stone also completed a friendly merger with Southwest Forest Industries in 1987 for $760 million, adding another linerboard mill and branching out into newsprint.

While the majority of recent deals have involved papermaking assets, a few firms have looked outside the industry for expansion opportunities. One example is Fort Howard, which paid $500 million in 1983 for Maryland Cup Corp., a maker of disposable packaging products for the commercial and industrial market. In 1986, the company expanded its cup market share from about 18% to 31% with the purchase of Lily-Tulip Inc. for $326 million. The deal moved Fort Howard ahead of James River's Dixie-Northern operation and into first place in the sanitary food container sector.

In July 1988, Stone Container bought Trinity Paper & Plastics Corp., a major independent grocery sack converter. Stone planned to combine Trinity with its Retail Bag operations, and then divide that into multiwall packaging and flexible packaging. In 1989, Pope & Talbot bought four disposable diaper manufacturing plants from Georgia-Pacific for an undisclosed amount.

Leveraged buyouts surge. In an LBO, a small group of investors—often composed of company management—finances an acquisition through loans secured by the assets being purchased, and the loan is then repaid from funds generated by company operations or the sale of company assets. LBOs have been used successfully to finance paper-industry acquisitions through much of this decade, but funds were becoming tighter in later years.

The main reason for the popularity of LBOs was the opportunity for great profit. For example, Ecusta Corp. was taken private for $130 million in 1985 in a buyout from Olin Corp.; in 1987, Ecusta was sold to P.H. Glatfelter Co. for $219 million. LBOs have also been used to escape hostile takeovers. National Gypsum Co. went private in 1986 in a $1.1 billion buyout to escape a takeover attempt by the Canadian investor Samuel Belzberg.

The biggest name in the LBO industry is Kohlberg Kravis Roberts. In 1987, KKR bought out Owens-Illinois and Jim Walters Corp. for $3.66 billion and $2.44 billion, respectively. In both cases, paper industry assets were sold off to help finance the deals. Great Northern Nekoosa was the buyer in both cases, purchasing O-I's Forest Products Group in 1987 for $1.17 billion and Jim Walters Papers in 1988 for an undisclosed sum.

The huge debts incurred in such transactions can adversely affect the final outcome of these strategic investments. The Fort Howard LBO in late 1988 rang up the biggest bill yet for any acquisition in the North American pulp and paper industry. Realizing the weight of its debt as the company's profits softened, Fort Howard put its cup business up for sale in 1989. This could provide the funds needed to add two more tissue machines at Rincon, Ga., where a fourth paper machine was to start up in 1990, but was delayed because of finances.

Georgia-Pacific's bid for Great Northern Nekoosa would more than double G-P's 1988 debt level of $3 billion, as all of the acquisition costs were to be financed through a group of banks. Other bidders were expected to drive the final price for GNN up to levels that even G-P might not be able to afford, leading to speculation that a foreign buyer might win out in the end. G-P had bid $58/share for GNN's outstanding shares one day before they jumped by $20.125 to $62.875. Some observers expected the price to go as high as $75/share.

Foreign interests. A significant number of recent acquisitions in the U.S. paper industry have been made by foreign companies. The portion of foreign investment appears to have risen in recent years as domestic funds shrank. The Japanese made their first direct purchase of a U.S. paper mill only in 1987, when Daishowa purchased an uncoated groundwood paper mill at Port Angeles, Wash., from James River for $75 million. Daishowa and Louisiana-Pacific had announced in February 1987 that Daishowa would buy Fibreboard Corp. for $160 million, but the deal fell through for unexplained reasons in June 1987.

Also in 1987, Settsu Corp. of Japan acquired a 21.5% interest in Caraustar Industries Inc., the fourth-largest U.S. producer of recycled paperboard. Settsu, Japan's largest recycled board producer, purchased the stake to give it a presence in the U.S. market.

Australians were also active in the U.S. market in 1987. FSC Paper Corp. was sold to Smorgon Consolidated Industries Pty Ltd. in May. Smorgon, a recycled containerboard producer based in Melbourne, said it purchased the mill as a stepping stone into the U.S. market. In July, a little-known Australian company called Pratt Holdings Pty Ltd. acquired the Macon, Ga., mill of Georgia Kraft Co. for an undisclosed amount.

In mid-1989, MD Papier of Fed. Rep. Germany and Great Northern Nekoosa were considering a joint-venture lightweight coated groundwood paper mill in Maine. Canadians have also been more active in U.S. acquisitions, especially since currency exchange rates have made U.S. investment more attractive. Abitibi-Price and Parsons & Whittemore Inc. are jointly building a newsprint mill in Claiborne, Ala., that is scheduled to come online late in 1990.

Many U.S. companies are also looking more closely at European investments before trade barriers within the Common Market countries are eliminated in 1992. Jefferson Smurfit Group's chairman Michael Smurfit, a long-time advocate of a strong global presence, said he wanted to become less dependent on North American investments and to invest more in Europe "to provide a better long-term balance of earnings in the future and to prepare for the European market of 1992."

Federal Paper Board early in 1989 acquired Scottish white paper producer Thomas Tait & Sons Ltd., which sells its own papers in Europe. Besides giving Federal a manufacturing presence in the Common Market, the acquisition expands the company's production base and reduces its exposure to price fluctuations in the pulp market. International Paper bought Aussedat Rey SA for FF2.03 billion, and Scott acquired Cross Paperware in the U.K. for about $26 million. Gaylord Container and Central National-Gottesman Inc. agreed to a joint venture called Gaylord Central National that will market Gaylord's products overseas.

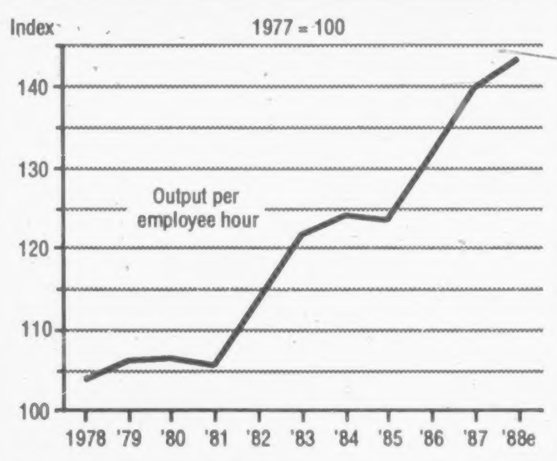
United States:

LABOR

In October 1988, the United Paperworkers International Union (UPIU) unconditionally ended its 16-month strike against three of International Paper Co.'s mills. The end of the strike reflected some developing patterns in labor-management relations: premium pay for Sunday and holiday work is becoming a thing of the past; companies can and will effectively run their mills with salaried people or replacement workers in the event of a strike; and the pooled voting strategy attempted by several UPIU locals working for IP is not necessarily successful.

Perhaps one of the most significant developments to come out of the IP strike is the dramatic decrease in the number of strikes since then. Through the first seven months of 1989, there was only one strike in the paper industry, compared with 19 in 1984. This suggests that UPIU is reluctant to call strikes after its experience with IP, which successfully replaced its striking workforce. By mid-1989, only 117 out of 2,300 union members had been rehired at the three IP mills. While a strike can still be a tough weapon in a union's arsenal, its costliness and the ability of employers to respond quickly and dramatically may cause un-

PRODUCTIVITY OF PRODUCTION WORKERS AT PULP, PAPER, AND BOARD MILLS



Source: Bureau of Labor Statistics.

U.S. PAPER AND ALLIED PRODUCTS EMPLOYMENT AND EARNINGS, 1965-88

Year	All employees (000)	Production workers (000)	Average hourly earnings	Average weekly earnings
1988	n.a.	n.a.	n.a.	n.a.
1987	678.2	515.0	$11.41	$492
1986	674.3	511.4	11.14	483
1985	677.7	512.1	10.83	467
1984	680.9	511.6	10.41	449
1983	661.2	494.5	9.93	423
1982	662.4	493.9	9.32	390
1981	688.5	518.4	8.60	366
1980	692.8	522.7	7.84	331
1979	706.8	535.6	7.13	304
1978	698.7	524.7	6.52	280
1977	691.6	518.2	5.96	256
1976	675.5	508.3	5.47	232
1975	642.0	479.7	5.01	208
1974	706.1	544.3	4.53	191
1973	704.6	543.1	4.20	180
1972	688.9	531.6	3.95	169
1971	681.9	521.8	3.67	155
1970	705.5	543.2	3.44	144
1965	639.1	497.7	2.65	114

Source: Bureau of Labor Statistics.

ion leaders to seriously consider other options.

Headquartered in Nashville, Tenn., UPIU is the largest U.S. pulp and paper workers' union. It represented about 240,000 members in 1989; about 3,000 of this total are employed in Canadian mills. Workers at mills on the Pacific Coast are almost entirely represented by the Assn. of Western Pulp & Paper Workers (AWPPW), the main office of which is located in Portland, Ore. AWPPW represented approximately 15,000 workers in 1989.

Besides these two major organizations, smaller numbers of pulp and paper workers belong to other unions ranging from the International Assn. of Machinists & Aerospace Workers to the United Steelworkers of America.

UPIU and AWPPW membership has been declining since 1980, reflecting a trend in overall employment at the mill level. The unions, therefore, have been unable to wield as much power as in the past. Diminished union bargaining clout and company insistence on cost-cutting measures to remain competitive have resulted in union concessions to modest wage increases, among other things.

UPIU ideally would like to negotiate on a national level with IP and other paper companies. This "pooled voting" strategy would give it more clout, similar to what union members in Canada enjoy when they negotiate new contracts. Specifically aimed at the large, integrated, multifacility companies, pooling is designed to control ratification of contracts by putting all facilities up for negotiation at the same time. With some degree of success, UPIU employed this tactic during its bargaining with Champion International Corp. and Boise Cascade Corp. But in order to ensure future viability, pooling would require that contracts at a company's mills lapse at the same time, and companies are not likely to acquiesce.

Bargaining in 1989. About 120 mills were scheduled for bargaining in 1989. Undoubtedly, management demanded the elimination of Sunday premiums from the majority of contracts with such provisions. Labor consultant Julian M. Kien noted that the union agenda in 1989 included support for child-care provisions, parental leave, retiree benefits, and possible further tightening of the plant closure notification bill. Labor pushed for and won the Worker Adjustment & Retraining Notification Act (WARN), which dictates that employers of 100 workers or more are required to give 60 days' advance public notice when shutting down plants or making mass layoffs.

In addition, more companies are trying to implement flexible work rules by keeping employees informed about the competitiveness of mills. For example, in fall 1988, Kimberly-Clark Corp. informed employees at Coosa Pines, Ala., that the mill was a high-cost producer and that modernization was needed to maintain it as a viable enterprise. Union members agreed to accept work rule changes, and K-C agreed to spend $200 million to modernize the mill.

During the mass layoffs in manufacturing earlier this decade, workers sacrificed wages to keep their jobs; now they do so to keep their benefits intact. Despite an inflation rate that has been running 4.4% to 5.3% annually since 1987, workers are settling for increases of only 2% to 3% in the second and third years of their contracts. Paper industry settlements fell from a high of 10% in 1980 to an average first-year increase of 0.3% in 1986.

According to statistics from the American Paper Institute, in 1988 the average first-year wage increase was 0.7%. The second-year average was 2.0%,

HOURLY EARNINGS OF U.S. PAPER AND ALLIED INDUSTRY PRODUCTION WORKERS, 1981-88

	1988	1987	1986	1985	1984	1983
Paper and allied products	n.a.	$11.41	$11.14	$10.82	$10.41	$9.93
Paper and pulp mills[1]	n.a.	14.00	13.59	13.13	12.43	11.70
Paperboard mills	n.a.	14.26	14.00	13.60	12.99	12.11
Misc. converted paper products	n.a.	n.a.	9.58	9.32	9.09	8.71
Paperboard containers/boxes	n.a.	n.a.	9.54	9.23	8.92	8.60
All U.S. manufacturing	n.a.	9.90	9.73	9.53	9.19	8.83

n.a. = Not available.

1. Includes construction paper/board mills.

Source: Bureau of Labor Statistics.

TOTAL U.S. PAPER AND ALLIED PRODUCTS INDUSTRY EMPLOYMENT BY SEGMENTS, 1982-88

(000 employees)

	1988	1987	1986	1985	1984	1983	1982
Paper and allied products	690.7	684.4	674.3	677.7	680.9	661.2	653.0
Paper and pulp mills[1]	191.4	191.2	195.2	197.0	200.0	198.0	196.6
Paperboard mills	52.9	53.7	53.3	55.3	57.2	58.2	59.5
Misc. converted paper products	237.4	233.4	229.5	228.5	226.5	214.4	208.4
Paperboard containers/boxes	211.5	206.5	196.3	196.9	197.2	190.6	188.5

1. Includes construction paper/board mills.

Source: Bureau of Labor Statistics.

and the third-year average was 2.1%. Of the 43 contracts settled by mid-year 1989, the average first-year wage increase was 1.1%, the second-year average was 2.5%, and the third-year average was 2.6%.

The company practice of giving lump-sum payments in lieu of a first-year increase is now a permanent fixture of bargaining. This concept has been beneficial for companies both in maintaining a lower base wage and in reducing the multiplier effect on benefits and pensions in any one year.

Even with the recent reductions in contract wage settlements, hourly earnings of paper and allied industry production workers in 1988 averaged $11.78/hour. In 1987, earnings averaged out to $11.44/hour.

While the rate of wage increases seemed to be moving upward, two-tier settlements were becoming more conspicuous in 1988 and 1989. Essentially, the larger, integrated companies settled with a zero in the first year and a 2% to 2.5% wage increase in later years, according to analyst Julian Kien. Smaller, nonintegrated mills settled at between 2.3% and 3.5% for later years of their contracts. Furthermore, with unions using their leverage against smaller companies, a two-tier pattern is emerging in the reduction of premium costs—specifically, pay for Saturdays, Sundays, and holidays.

Richard P. Klinzing, vice president of employee relations for API, said that paper companies want to stabilize their labor costs. Consequently, most contracts settled in 1988 and 1989 were for three years or longer. Through the first half of 1989, 41 of the contracts reached were for three or more years; 18 of that number were for four years' duration or longer. IP settled a six-year pact at Mobile, Ala., while Boise Cascade Corp. settled for six years at Rumford, Maine. A significant number of contracts have been opened early and extended. In 1987, four mills reported such early settlements. By mid-1989, the number had reached 15.

On Oct. 8, 1988, UPIU locals representing about 2,300 IP workers at Jay, Maine; Lock Haven, Pa.; and De Pere, Wis., offered to return to work and demanded bargaining sessions with IP mills to resolve the conflict as soon as possible. IP insisted that the workers it hired to replace the strikers were permanent; however, strikers would be legally entitled to first preference for any job openings at the mills.

The outcome of the strike shocked many union members. UPIU president Wayne Glenn was reelected by a large margin at the union's convention in 1987—a vote that most of the membership regarded as a mandate to continue the strike and the corporate campaign they were waging against IP. Additionally, members voted to double the strike fund. But strikers began to lose hope after more than a year of walking the picket line, and UPIU decided to end the strike as a "strategic move" to force IP to rehire strikers when openings became available.

The end of the strike sent a message to other locals working under implemented contracts or without contracts: holding out for Sunday premium pay is futile. The effectiveness of striking was also put into question. "It's the only weapon a union has available to it, but I do think that the effectiveness of strikes has been significantly reduced by the ability of a company to run a mill on strike with salaried employees and to use replacements in the event there's

AVERAGE FIRST-YEAR WAGE INCREASES IN U.S. PULP AND PAPER INDUSTRY, 1979-89

Year	New England	East	Midwest	South	Pacific	Total U.S.
1989*	1.2%	2.8%	0.5%	1.0%	0.0%	1.0%
1988	0.4	1.9	1.1	0.2	0.5	0.9
1987	0.3	1.3	0.6	0.1	0.0	0.4
1986	1.0	0.6	0.5	0.1	0.2	0.3
1985	2.3	3.4	3.2	1.6	-1.1	2.1
1984	4.9	4.3	4.6	5.3	-0.9	3.3
1983	5.8	5.2	5.1	5.9	1.3	5.6
1982	7.3	6.7	6.6	6.8	7.7	6.9
1981	8.8	9.0	8.5	8.2	9.0	8.7
1980	10.7	9.8	9.3	8.7	9.8	9.2
1979	9.6	9.4	9.5	10.0	10.0	9.6

* = Through first half.

Source: American Paper Institute.

U.S. PAPER WORKERS UNIONS

Union	Region represented	Members: Total	Members: Primary pulp and paper
United Paperworkers International Union	U.S.	230,000*	54,000
Assn. of Western Pulp & Paper Workers	Western U.S.	16,500	16,500

* = Includes approximately 40,000 employed in areas such as chemicals and hospitals. International Assn. of Machinists & Aerospace Workers, International Brotherhood of Electrical Workers, and other major unions also have representation at U.S. mills.

no chance of coming to terms," said Julian Kien.

UPIU and other unions are also lobbying Congress to limit companies' rights to replace striking workers permanently. The legislation, introduced by U.S. Rep. Joseph Brennan (D-Maine), gained some momentum during 1989 after the labor dispute at Eastern Airlines.

PRODUCTIVITY INDEXES FOR U.S. PAPER AND ALLIED PRODUCTS

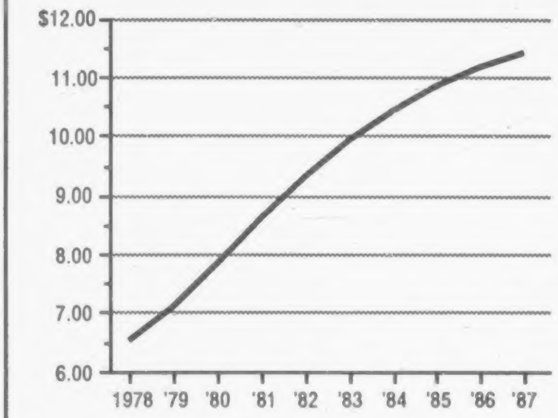
(output per employee hours; 1977 = 100)

Year	Production workers	All employees
Pulp, paper, and board mills		
1988e*	143.2	139.8
1987	139.8	136.4
1986	131.4	128.8
1985	123.6	122.2
1984	124.0	121.9
1983	121.4	119.6
1982	113.7	111.3
1981	105.5	104.4
1980	106.4	105.2
1979	106.2	105.4
Average annual percent change 1979-85	3.3%	3.2%
1978	103.7	103.2
1977	100.0	100.0
1976	95.0	95.0
1975	87.7	86.7
1974	90.5	91.5
1973	90.2	91.5
1970	75.8	77.5
1960	48.8	50.6
1954	37.9	40.4
Average annual percent change 1947-85	4.1%	3.7%
Corrugated and solid fiber boxes		
Average annual percent change 1958-85	4.0%	3.7%
1973-85	2.6%	2.5%
Folding paperboard boxes		
Average annual percent change 1963-85	1.9%	1.8%
1973-85	0.6%	0.6%

* = American Paper Institute data.
e = Estimate.

Source: Bureau of Labor Statistics.

AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS



Source: Bureau of Labor Statistics.

REPRESENTATIVE BASE-WAGE RATES FOR REGIONS OF NORTH AMERICA, 1970-89

Year	U.S. South	U.S. West	Canada Eastern	Canada B.C.
1989	—	—	C$15.37	C$16.17
1988	—	—	14.71	15.33
1987	$13.59*		14.26	14.48
1986	—	—	14.01	14.09
1985	—	—	13.34	14.09
1984	9.51	11.22	12.83	13.48
1983	9.07	11.19	12.52	12.96
1982	8.56	11.05	11.38	12.96
1981	7.91	9.37	10.16	11.46
1980	7.28	8.53	9.23	9.96
1979	6.74	7.90	7.89	9.06
1978	6.13	7.25	7.46	8.16
1977	5.57	6.59	6.99	7.61
1976	5.04	5.96	6.47	6.89
1975	4.58	5.26	5.88	6.14
1974	4.15	4.78	4.57	5.10
1973	3.78	4.32	4.21	4.45
1972	3.48	4.02	3.85	4.09
1971	3.28	3.76	3.51	3.80
1970	3.09	3.45	3.25	3.50

* = National average.

Sources: *Pulp & Paper Week*, American Paper Institute.

United States:

TIMBER RESOURCES AND PULPWOOD COSTS

The Pacific Northwest supplies about 50% of U.S. lumber, while Canada and the U.S. South supply the rest. During 1989, timber sales on federal land in the Northwest came to a standstill because of court injunctions put in place while the Fish & Wildlife Service and the U.S. Forest Service (USFS) developed a forest management plan that would protect the northern spotted owl. This has caused the price of timber, and consequently the price of woodchips, in that region to rise dramatically since 1988.

It has also caused a rash of timber sales in the region as companies try to secure timber. During the last three years, according to First Boston, there have been seven major timber transactions in the West. Louisiana-Pacific Corp. bought 100,000 acres from Timber Realization; Maxxam bought Pacific Lumber; Georgia-Pacific Corp. bought American Forest Products; Santa Fe Railroad sold its timberland to Sierra Pacific; Roseburg Forest Products bought two large tracts of land; Scott Paper Co. sold a 200,000-acre piece of land to Crown Pacific; and Burlington Resources sold some of its Plum Creek Timber Co. land.

The Scott sale shows just how much timberland has appreciated. Scott had been looking for a buyer for the land since 1983. The sale it finally completed was at the handsome sum of $1,186/acre. One analyst noted that if Scott had sold the land a year earlier, it would have received only $700 to $800/acre.

Timberland in the Northwest is currently priced high enough to enable buyers to get financing for timber purchases. This is not generally true of the South, where returns on timber sales have been very low for several years. As it is, buyers of forestland in the Northwest usually have to harvest the timber on the land soon after sale in order to repay the debt.

In the short term, the timber supply crunch in the Northwest will put companies that supply much of their sawmills with fee-owned timber in a better position than those that are dependent on purchased logs. Companies in the first group are Weyerhaeuser Co., Potlatch Corp., Champion International Corp., and Louisiana-Pacific. Pope & Talbot Inc. and WTD Industries, both of which want to build pulp mills in the region, mainly rely on purchased logs.

Demand for wood products is no longer so closely tied to housing starts. In 1989, housing starts are expected to reach 1.35 million—down from 1.5 million in 1988. However, the repair and remodeling market is taking up the slack. In 1990, housing starts could rise again because of lower interest rates. This would make demand for timber in the Northwest even stronger, and it would raise lumber demand in the South as well.

PROJECTED FUTURE U.S. DEMAND FOR TIMBER PRODUCTS, 1976-2030

			Projected demands—medium level	
Product	**Standard unit of measure**	**Consumption 1976**	**2000**	**2030**
Lumber	Billion bd ft	42.7	59.9	67.3
Plywood	Billion ft^2, $^3/_8$-in. basis	20.7	30.1	34.1
Board (particleboard, insulating board, hardboard)	Billion ft^2, $^3/_8$-in. basis	13.5	27.3	37.3
Pulpwood (U.S. mills)	Million cords	75.2	127.7	178.4
Other industrial products	Million ft^3	379.0	800.0	900.0
Fuelwood (roundwood)	Million cords	8.1	18.7	30.7
Total roundwood, sawtimber	Billion ft^3	13.3	22.7	28.3

Source: U.S. Forest Service, "An Analysis of the Timber Situation in the U.S., 1952-2030," 1982.

U.S. TIMBER RESOURCE

The growing stock in U.S. forests increased from about 603 billion ft^3 in 1960 to about 711 billion ft^3 in 1987, the American Forest Council (AFC) estimated. U.S. forestland totals about 737 million acres. Of this, about 482 million acres are commercial (land capable of growing over 20 ft^3 of wood/acre/year), according to AFC. Fifty-eight percent of the land, about 279 million acres, is privately owned. (AFC estimated that there are about four million individual woodland owners in the U.S.) About 13% of commercial U.S. forestland, or 67.5 million acres, is owned by industry, and 135 million acres are public lands owned by federal, state, and local governments.

Under the National Forest Management Act of 1976, USFS must make resource management plans for each of the 123 national forests it manages. The forest-products industry believes that current timber sales levels are far be-

U.S. PULPWOOD RECEIPTS

(000 standard cords, rough wood basis)

Year	Total receipts	Total domestic	Domestic		Total imported	Imported	
			Softwoods	Hardwoods		Softwoods	Hardwoods
1988	95,602	94,514	n.a.	n.a.	1,088	n.a.	n.a.
1987	93,890	93,090	n.a.	n.a.	800	n.a.	n.a.
1986	90,623	89,788	n.a.	n.a.	835	n.a.	n.a.
1985	85,349	84,561	n.a.	n.a.	788	n.a.	n.a.
1984	88,035	87,114	n.a.	n.a.	921	n.a.	n.a.
1983	82,390	81,587	58,959	23,431	803	n.a.	n.a.
1982	73,541	72,524	n.a.	n.a.	1,016	n.a.	n.a.
1981	79,336	78,283	n.a.	n.a.	1,053	n.a.	n.a.
1980	81,007	80.320	59,582	20,738	687	588	99
1979	76,928	76,124	56,741	19,383	804	698	106
1978	74,824	73,970	54,803	19,167	854	764	90
1977	72,867	72,094	54,680	17,414	773	709	65
1976	72,265	71,443	53,689	17,753	882	744	78
1975	65,456	64,836	48,759	16,079	618	521	96
1974	77,103	76,262	55,531	658	841	658	183
1972	70,273	69,254	51,793	17,461	1,020	884	135
1970	68,863	67,723	53,356	16,367	1,140	994	146

Year	Northeast[1]	North Central	South Atlantic	South Central	West
1988	6,292	6,786	58,326[2]		13,019
1987	5,938	6,583	57,673		12,807
1986	6,267	6,768	55,439		11,937
1985	6,081	5,916	52,620		11,320
1984	5,842	5,271	26,640	26,322	11,824
1983	7,357	6,777	24,544	28,457	15,261
1982	7,075	5,160	23,580	24,725	13,001
1981	7,623	5,537	25,146	26,521	14,509
1980	7,159	5,969	n.a.	n.a.	16,496
1979	6,777	5,956	n.a.	n.a.	14,477
1978	6,892	5,522	25,353	25,678	13,483
1977	5,887	5,364	n.a.	n.a.	14,937
1976	5,712	5,441	n.a.	n.a.	14,766
1975	5,320	4,574	19,907	22,151	13,504
1974	6,547	6,401	23,414	24,953	15,986
1972	5,398	4,935	22,334	23,113	14,492
1970	5,958	5,245	21,835	20,493	15,367

n.a. = Not available.

[1] Regional statistics for 1984 to present do not add to total because of difference in method of reporting.

[2] Figures for 1985 to present are for entire South.

Source: Bureau of the Census, "Current Industrial Reports Series M26A" (87-1).

low the productive capacity of the national forest system. National forests contain over 50% of the harvestable sawtimber in the U.S.

In October 1989, the natural resources bill for fiscal year 1990 was belatedly settled. The bill provides for timber sales in the Northwest of 7.7 billion bd ft in 1989 and 1990. In 1989, USFS offered for sale about 2.4 billion bd ft in the region, so 5.3 billion bd ft will be offered during 1990. Another 1.9 billion bd ft will be offered for sale in the region by the Bureau of Land Management. Most of the BLM land is in Oregon.

Total timber sales from USFS land during fiscal year 1990 equal 11.983 billion bd ft. In the opinion of industry, the bill provides adequate funding for road construction to reach the timber. Industry was less pleased with provisions that expanded protection for the spotted owl. However, Congress mandated that no federal timber sales will be subject to preliminary injunctions in 1990. Any challenge to a sale must be filed in federal district court within 15 days of the sale's advertisement. A review court must decide on such challenges within 45 days.

In 1987, 12.7 billion bd ft of timber were harvested from federal land, although 11.47 billion bd ft were sold. In 1988, 12.6 billion bd ft were harvested vs 11.3 billion bd ft sold. (These differences are possible because a purchaser has three years to harvest land after a sale.)

The forest-products industry is particularly concerned because high timber demand has resulted in steep erosion in the reserve volume of national-forest timber now under contract. Reserve volume in the national forests amounted to 38.1 billion bd ft in 1985, but it is now less than 25.1 billion bd ft.

According to the American Tree Farm System, it takes a 100-ft tree (about 0.75 cords) to keep the average American supplied for a year. That works out to 613 lb of paper products, 200 ft^2 of 1-in.-thick lumber, 87 ft^2 of plywood, and 59 ft^2 of insulating board, particleboard, and hardboard per person.

According to the American Pulpwood Assn. (APA), U.S. paper and board mills consumed 95.497 million cords of pulpwood in 1988—a 1.7% increase from 1987 levels. Between 1950 and 1987, the hardwood proportion of total U.S. pulpwood consumption climbed from 13.6% to 30.6%.

Southern U.S. APA reported that pulp mills in the South Atlantic region used 31.567 million standard cords of pulpwood in 1988—a 2.1% increase over 1987. In the South Central region, mills consumed 33.65 million cords—a 1.8% increase.

A study released in 1987 by USFS entitled "The South's Fourth Forest: Alternatives for the Future" found that about 85 million acres, or 57% of the total land area in the Southeast, are classified as timberland. About 26% is in natural pine, 15% in planted pine, 11% in oak-pine, 16% in lowland hardwood, and 32% in upland hardwood. Hardwood accounts for 59% of the forestland in the South.

About 75% of the hardwood trees grow on private forestland, 14% is owned or leased by the forest industry, 7% is national forestland, and 4% is on land held by states or municipalities. The most striking feature about the hardwood resource is that about 12 million acres lack a manageable stand of timber. Almost half of the hardwood stands are over 50 years old.

Along with increased demand for hardwood, these factors will contribute to a decline in hardwood growth. USFS estimates that hardwood growth will decline until about 2010, after which growth rates will probably stabilize. Hardwood harvests will exceed renewal after 2000. In contrast, softwood growth is expected to recover before 2000.

Like the Northwest, the South has had timber sales curtailed because of a bird, in this case the red-cockaded woodpecker, which has been declared an endangered species. In the South, 65 timber sales from federal forestlands are tied up because of the woodpecker. Unlike the Northwest, however, sawmills in the South are not dependent on federal logs. And some pulp and paper companies have quite substantial timber holdings of their own in the South.

U.S. PULPWOOD CONSUMPTION

(000 standard cords, rough wood basis)

Year	Total consumption	Northeast	North Central	South Atlantic[1]	South Central[1]	West
1988	94,181	7,278	7,163	61,393		18,346
1987	92,386	7,303	7,005	60,586		17,492
1986	91,083	7,811	6,860	59,878		16,534
1985	84,841	7,650	6,209	55,631		15,351
1984	86,948	5,943	5,049	26,326	26,046	11,435
1983	82,386	7,384	6,683	24,814	28,314	15,186
1982	73,642	6,714	5,394	23,574	24,935	13,025
1981	79,350	7,043	5,865	25,228	25,457	14,757
1980	79,703	7,318	5,715	24,950	26,246	15,465
1979	77,362	6,748	5,728	24,426	25,421	15,038
1978	74,170	6,501	5,492	23,703	25,118	12,784
1977	73,935	5,949	5,473	22,817	24,668	15,063
1976	72,011	5,877	5,442	22,673	24,969	14,247
1975	65,421	5,417	4,779	19,983	22,042	13,200
1974	74,327	6,149	5,678	22,926	22,240	15,466
1972	71,538	5,878	5,222	22,395	23,212	14,831
1970	67,562	5,699	5,034	21,511	20,458	14,822

[1] Figures for 1985 onward are for entire South.

Source: Bureau of the Census, "Current Industrial Reports Series M26A."

In June 1989, USFS decided to prohibit logging within three-quarters of a mile of red-cockaded woodpecker colonies. The decision will affect timber sales from national forests in nine southern states and will force USFS to modify 80 existing timber sales contracts. USFS estimates that the woodpecker decision will reduce timber harvest in the Southeast by about 29 million bd ft in 1989. If the decision stands, it will reduce sales by 56 million bd ft in 1990 and by 25 million bd ft each year thereafter.

For some time, Japanese chip buyers have sought sources of supplies outside the Pacific Northwest. This is particularly true for hardwoods. Japanese trading companies have stepped up their imports of oak and gum from the southern U.S. The second-quarter 1989 export price of hardwood chips from the southeastern Atlantic/Gulf ports was between $85 and $95/bdu, f.o.b. vessel. So far, the Japanese have not shown interest in buying pine chips from the South.

In 1988, shipments of woodchips from Gulf Coast ports totaled 173,125 short tons, almost all of which went to Asia. This compares with just 66 short tons shipped in 1987, according to the Dept. of Commerce. Shipments of chips to Japan from the Gulf Coast made up only 8.5% of total shipments from the U.S. But over half of the chips imported from the U.S. by Taiwan came from the Gulf Coast. Rep. Korea has also bought hardwood chips from the South and plans to step up its purchases.

According to a report by the Alabama Development Office, companies in the Pacific Rim are interested in buying hardwood chips from the South because the market for southern hardwoods has been remarkably stable over the last ten years due to the abundance of hardwoods and to the historically low demand for hardwood pulpwood. The price jumped in 1987 because of increased demand, but since then it has leveled off. The opening of the Tennessee-Tombigbee Waterway has made it cost-effective to ship a low-value, high-volume product like chips to Mobile, Ala., for export.

Northern U.S. In the Northeast and Great Lakes region, private landowners control most of the timberland and supply roughly 80% of the timber harvested (primarily hardwoods). The demand for forest products is fairly stable, inasmuch as timber production is not the primary goal of the landowners of this region.

Pulpwood is supplied mostly in roundwood form, with growth far exceeding demand. Mills in the Northeast con-

PULPWOOD CONSUMPTION, EXPORTS, IMPORTS, AND PRODUCTION IN THE U.S., SPECIFIED YEARS 1952-84, WITH PROJECTIONS TO 2030

(million cords)

				Production				
					Roundwood			
Year	Consumption	Exports	Imports	Total production	Total	Softwoods	Hardwoods	Chips[1]
1984	91.4	1.9	1.8	91.5	54.8	34.7	20.0	36.8
1976	75.3	3.3	1.1	77.4	47.6	33.0	14.7	29.8
1970	69.6	2.0	1.1	70.5	50.2	36.7	13.6	20.2
1962	44.1	0.1	1.4	42.8	33.3	24.3	9.0	9.4
1952	27.2	—[2]	2.1	25.0	23.5	20.0	3.5	1.6

PROJECTIONS

				Demand				
					Roundwood from U.S. timberland			
Year	Demand in U.S. mills	Exports	Imports	Total demand	Total	Softwoods	Hardwoods	Plant by-products
1990	92.8	2.3	1.4	93.7	59.8	36.4	23.4	33.9
2000	105.2	1.9	1.3	105.8	69.5	39.4	30.1	36.3
2010	115.1	1.7	1.2	115.6	78.4	42.0	36.4	37.2
2020	124.6	1.6	1.1	125.1	86.6	44.4	42.2	38.5
2030	133.0	1.5	1.0	133.5	94.2	46.5	47.7	39.3

1. Includes primary processing plant byproducts, such as slabs, edgings, and veneer cores as well as unknown volumes of pulp chips produced directly from roundwood at logging sites and other locations remote from pulp mills.
2. Less than 50,000 cords.
Note: Data may not add to totals because of rounding.

Sources: U.S. Dept. of Agriculture, Forest Service. Derived from data published by the U.S. Dept. of Commerce, Bureau of the Census; American Paper Institute; and American Pulpwood Assn.
Projections: U.S. Dept. of Agriculture, Forest Service.

sumed 7.21 million cords of pulpwood in 1988, about 1.5% more than they used in 1987. Mills in the North Central region of the U.S. consumed 6.93 million cords, 2.4% more than they consumed in 1987, APA reported. Despite the demands being made on timber supply by firewood and biomass applications as well as waferboard production, growth is still expected to outstrip demand through 1990.

A problem surfacing in northern New England and New York State is that it is about five times more profitable for private landowners to sell their land to developers than to grow trees. The area contains about 32 million acres of forestland, much of which is owned by paper companies. About 20% of the 1 million acres that Diamond Occidental Forest Inc. sold in 1988 went to developers. In this land-use conflict, however, the industry and environmentalists are joining forces against the developers. USFS is compiling a study of forestland ownership and development in the region, which is scheduled to be completed in late 1989.

In the Great Lakes region, Wisconsin is actively trying to attract pulp mills in order to make use of its hardwood forest reserves. A study commissioned by the governor found that 21 areas in the northern two-thirds of Wisconsin could support a new pulp mill without violating the state's

TIMBER SALES FROM WESTERN WASHINGTON AND WESTERN OREGON

	Timber sold on publicly owned lands		National forest only	
Year	(billion bd ft)	($/000 bd ft)	Douglas fir ($/000 bd ft)	All species ($/000 bd ft)
1988	5.0	$195	$256	$206
1987	5.4	146	190	162
1986	6.2	109	161	128
1985	4.8	86	126	101
1984	5.0	94	133	95
1983	5.2	121	162	113
1982	5.6	93	118	80
1981	5.2	243	350	231
1980	5.7	314	432	432
1979	5.9	303	394	394
Average	5.4	$170	$232	$167

Source: Prudential-Bache Securities' Paper & Forest Products Quarterly Review, May 1989.

HISTORIC TRENDS IN U.S. PULPWOOD COSTS

	South				Wisconsin		West Coast
Second quarter	Roundwood pine $/cord[1]	Roundwood hardwood $/cord[1]	Greenchip pine, clean $/ton[2]	Greenchip hardwood, clean $/ton[2]	Roundwood aspen $/cord[3]	Roundwood jack pine $/cord[3]	Douglas fir chip, export $/bdu[4]
1989	$45.04	$38.29	$19.98	$15.80	n.a.	n.a.	$117.00
1988	42.94	35.40	20.34	17.01	n.a.	n.a.	78.20
1987	42.43	34.10	23.73	18.76	$32.50	$47.75	77.40
1986	41.69	31.57	23.52	17.65	32.00	56.00	79.40
1985	48.97	33.00	25.83	18.32	34.00	58.00	85.80
1984	48.43	32.52	25.96	17.75	32.00	50.85	78.00
1983	45.73	32.01	25.19	17.27	33.00	49.25	79.62
1982	42.86	31.71	22.93	16.20	35.00	54.75	100.75
1981	40.67	30.38	21.45	15.34	34.00	50.25	101.50
1980	40.16	30.77	18.50	14.38	32.65	43.50	113.25
1979	36.71	27.99	15.52	12.73	29.88	41.80	53.00
1978	34.00	26.60	14.30	12.10	27.38	34.46	n.a.
1977	32.20	25.50	13.80	11.60	25.25	35.88	n.a.
1976	31.20	25.50	13.50	11.20	24.75	30.82	n.a.

n.a. = Not available.

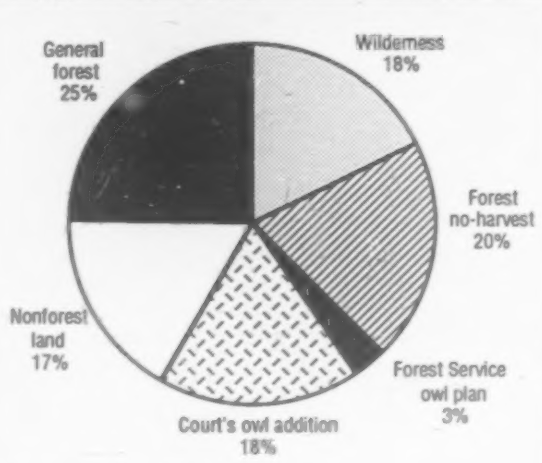
1. Average for 11 southern states, delivery to dealer yard (*Timber Mart-South*).
2. Average for 11 southern states, delivery to pulp mill through 1987. F.o.b. sawmill from 1988 forward (*Timber Mart-South*).
3. Median prices, delivery to mill (*Wisconsin Forest Products Price Review*).
4. F.a.s. to Japan.

Source: *Pulp & Paper Pricebook.*

environmental standards. Separately, MacMillan Bloedel Ltd. announced in mid-1989 that it would spend $74 million to build a parallel-strand lumber producing plant in Deerborn, Minn., based on the aspen stands in the region.

Pacific Northwest. In the Pacific Northwest, public agencies own slightly over half of the forestland. Unlike other areas of the country, the majority of pulp and paper fiber requirements (75% to 85%) is supplied from residuals from wood-products manufacturing. Pulpwood consumption in the West was equivalent to 16.14 million cords in 1988, an 0.2% increase over 1987.

NATIONAL FORESTLAND ALLOCATIONS IN WESTERN OREGON AND WASHINGTON



Total land = 12.0 million acres.

Source: U.S. Forest Service.

Domestic mills in the West compete with Japan for woodchips. The Pacific Northwest export price for Douglas fir chips to Japanese mills increased from $55/bdu in second-half 1979 to a peak of $131/bdu in second-half 1982. Unfortunately for pulp mills in the region, the price is again at this level. The second-half 1989 export price for Douglas fir chips was $133/bdu, f.o.b. vessel. This represents an increase of $15/bdu from the second quarter, a $35.30/bdu increase from the first quarter, and an increase of $46.30/bdu from second-half 1988. The second-half export price for red alder rose $7.50 from the first half to $124.50/bdu, f.o.b. vessel.

The big jump in the export price is indicative of mounting cost pressures that domestic mills in the region face. Mills in the Portland/Camas region at mid-1989 were paying $108 to $135/bdu for Douglas fir. According to Evadna S. Lynn of Merrill Lynch, it takes about 1.6 bdu of chips to produce one ton of kraft pulp.

At mid-1989, about 1.2 billion bd ft of timber sales in the Pacific Northwest were on hold because of court injunctions. The injunctions were put in place because of lawsuits brought by environmental groups concerned that the northern spotted owl will become extinct if logging of old-growth timber is permitted to continue. USFS and the Dept. of Fish & Wildlife have been collecting evidence on the owl that they hope to present in court so that timber sales can proceed. Normally, USFS offers about 4.8 billion bd ft for sale annually in the region. It was planning to reduce that amount even before the spotted owl controversy.

Because all timber off public land is sold by silent auction in the region, perception of a shortage has pushed the price up. During the 18 months prior to June 1989, 34 sawmills in the region closed. This caused some pulp mills to use chips made by wholelog chippers, which are more expensive than residual chips.

Another factor in the timber shortage is the power of the yen. Japanese companies have been buying a lot of raw logs from the Northwest, i.e., logs that do not run through a sawmill in the U.S. Some groups in the Northwest feel that export of raw logs should be prohibited. In June 1989, the citi-

U.S. EXPORTS AND VALUE OF WOODCHIPS

	Quantity			Average value	
Year	short tons	metric tons	Value	$/short ton	$/metric ton
1987	2,546,467	2,310,104	$188,459,018	$74.01	$81.58
1986	2,428,333	2,202,935	170,022,023	70.02	77.18
1985	2,317,989	2,102,833	168,813,781	72.83	80.28
1984	2,325,163	2,109,341	164,058,053	70.56	77.78
1983	2,554,176	2,317,097	171,269,000	67.05	73.92
1982	2,860,133	2,594,655	231,140,000	80.81	89.08
1981	3,846,049	3,489,059	314,037,000	81.65	90.00
1980	4,478,234	4,062,564	377,899,701	84.39	93.02
1979	4,498,674	4,081,107	197,846,642	43.98	48.48
1978	3,617,574	3,281,791	156,679,856	43.32	47.74
1977	4,037,901	3,663,103	178,223,078	44.14	48.65
1976	3,946,817	3,580,473	153,001,887	38.77	42.73
1975	3,177,204	2,882,296	115,384,797	36.32	40.03
1974	3,865,780	3,506,958	113,929,56[illegible]	29.47	32.49
1973	3,480,840	3,157,748	85,727,15[illegible]	24.63	27.15
1972	2,524,415	2,290,099	57,070,248	22.61	24.92
1971	1,978,731	1,795,065	41,123,878	20.69	22.91
1970	2,418,161	2,193,707	36,634,138	15.15	16.70

Source: Bureau of the Census.

zens of Oregon overwhelmingly passed a referendum that prohibited the export of raw logs from state-owned land. Idaho permits only 5% of timber from state-managed lands to be exported. Both of these laws challenge a 1984 U.S. Supreme Court ruling that struck down a similar law in Alaska. Oregon congressmen have also introduced legislation to turn a long-standing ban on exporting raw logs from federal land into a law. Interestingly, demand for export logs could drop off anyway if the dollar becomes stronger.

The collapse of the timber sale system that occurred in 1989 will have dramatic repercussions if the winter is bad, and most woodfiber managers tried to stockpile chips against this eventuality. Adding to uneasiness is the fact that sawmills do not have a backlog of uncut timber under contract. The amount of timber bought but not harvested was at a 20-year low at mid-1989.

The result of all this is that the West is becoming the high-cost region of the U.S. for pulp and paper mills to do business. This could prompt them to use more wastepaper in their furnish, as Longview Fibre Co. is doing. It will also increase the flow of chips down from British Columbia.

U.S. PULPWOOD PRICES (CHIPS)

(US$/ton, f.o.b. sawmill; average for 11 southern states)

	Greenchips (clean)	
Year	Pine	Hardwood
1989		
2Q	$19.98	$15.80
1Q	20.16	15.70
1988		
4Q	20.51	16.62
3Q	20.56	16.50
2Q	20.34	17.01
1Q	20.84	16.98
1987		
4Q	20.12	17.02
3Q	18.76	14.05
2Q	23.73	18.76
1Q	23.60	18.52
1986		
4Q	22.58	17.55
3Q	22.63	17.49
2Q	23.52	17.65
1Q	24.01	17.71
Year-end		
1985	24.04	17.66
1984	26.18	18.03
1983	25.68	17.64
1982	23.83	16.52
1981	21.82	15.01
1980	19.30	14.72
1979	16.71	12.97

Note: Beginning in third-quarter 1987, all chip prices are quoted f.o.b. sawmill rather than f.o.b. consuming mill.

Source: *Timber Mart-South.*

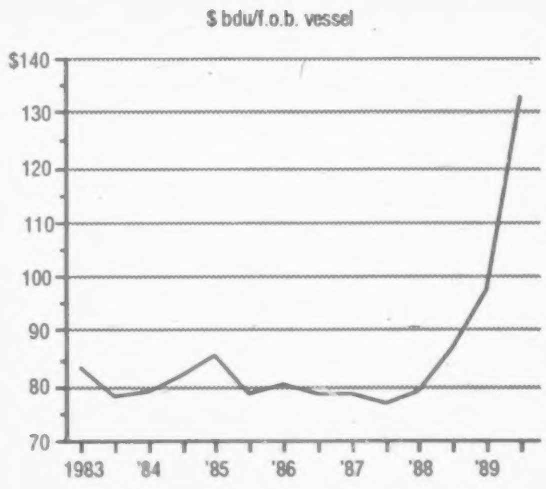
U.S. PULPWOOD PRICES (ROUNDWOOD)

US$/cord, delivered to dealer yard; average for 11 southern states)

Year	Pine	Hardwood
1989		
2Q	$45.04	$38.29
1Q	45.05	38.11
1988		
4Q	42.90	36.25
3Q	43.00	37.12
2Q	42.94	35.40
1Q	42.84	36.03
1987		
4Q	41.67	33.96
3Q	41.46	33.73
2Q	42.43	34.10
1Q	41.55	33.40
1986		
4Q	40.91	31.68
3Q	39.92	30.64
2Q	41.69	31.57
1Q	43.68	32.20
Year-end		
1985	45.17	31.89
1984	48.75	32.98
1983	47.72	32.43
1982	43.28	31.90
1981	40.99	30.60
1980	43.32	30.95
1979	37.95	30.00

Source: *Timber Mart-South.*

EXPORT PRICE OF DOUGLAS FIR CHIPS FROM PACIFIC NORTHWEST TO JAPAN



Source: Pulp & Paper Week.

U.S PULPWOOD PRICES (PINE AND MIXED HARDWOOD)

(US$/cord, f.o.b. car; state average for Louisiana)

Year	Pine	Mixed hardwood
1989		
2Q	$48.05	$37.52
1Q	49.39	n.a.
1988		
4Q	54.20	$46.13
3Q	51.93	45.51
2Q	53.76	48.90
1Q	49.01	46.80
1987		
4Q	51.57	46.28
3Q	51.06	44.56
2Q	46.56	45.46
1Q	53.49	45.05
1986		
4Q	48.20	41.21
3Q	47.79	34.91
2Q	n.a.	n.a.
1Q	23.68	22.94
Year-end		
1985	41.00	35.31
1984	48.00	n.a.
1983	n.a.	n.a.
1982	47.08	35.68
1981	44.85	34.83
1980	39.75	31.96
1979	40.80	33.45
1978	35.65	28.65

n.a. = Not available.

Source: *Louisiana Forest Products Quarterly Market Report.*

U.S. TIMBER HOLDINGS OWNED OR CONTROLLED BY MAJOR U.S. PAPER COMPANIES

Company	Acreage (000 acres)
Weyerhaeuser	19,157[1]
IP Timberlands	6,500
Georgia-Pacific	6,490
Champion International	6,444
Boise Cascade	6,247
Great Northern Nekoosa	3,680
James River	3,617
Scott Paper	2,900[1]
Union Camp	1,705
Louisiana-Pacific	1,538

1. Includes Canadian holdings.

Source: 1988 annual reports.

JAPANESE CHIP PRICES FROM U.S. AND AUSTRALIA

Year	Douglas fir (US$/bdu f.a.s.)	Alder	Eucalyptus (A$/bdu f.o.b.)
1989			
2nd half	$132.00	$123.50	n.a.
2Q	117.00	116.00	n.a.
1Q	96.70	116.00	n.a.
1988			
2nd half	85.70	110.00	$147.00
1st half	78.20	102.50	141.50
1987			
2nd half	75.70	94.00	135.25
1st half	77.40	94.00	130.00
1986			
2nd half	77.40	89.75	125.00
1st half	79.40	88.25	111.80
1985			
2nd half	81.40	88.25	108.20
1st half	84.80	89.75	101.00
1984			
2nd half	80.90	87.00	90.50
1st half	78.00	87.00	88.00
1983			
2nd half	77.00	85.00	85.00
2Q	80.00	85.00	82.00
1Q	84.50	85.00	82.00
1982			
4Q	96.00	90.00	82.00
3Q	102.00	90.00	82.00
1st half	102.50	86.50	82.00
1981			
2nd half	101.75	86.00	79.00
2Q	100.00	88.00	78.00
1Q	101.00	89.00	78.00

Source: Japan's *Paper Business Review.*

United States:

ENERGY USE AND CONSERVATION

Since the oil shocks of the 1970s, the U.S. paper industry has made enormous strides in reducing energy purchases and promoting energy efficiency. According to the American Paper Institute's Energy & Materials Dept., purchased fossil fuel and electricity accounted for 43.5% of the industry's total energy usage in 1988, down from 59.7% in 1972, a year before the OPEC oil embargo. The industry reduced its use of residual fuel oil by 59% between 1972 and 1988, API reported, while increasing production of pulp and paper products by 45%. In 1988, fuel oil accounted for about 7.5% of the energy consumed by the industry, compared with 21.2% in 1972.

Self-generated power increased from 40.3% of overall usage to 56.5% during the 1972-88 period. Spent pulping liquor is the main source of self-generated fuel, followed by bark and woodwaste.

Energy efficiency, measured by purchased energy used per ton of output, improved 42% between 1972 and 1987, according to API. But because of lower energy prices, particularly for natural gas, energy efficiency declined 2.3% between 1986 and 1987—the first year-to-year decline since API began tracking this statistic in the 1970s.

Natural-gas use has declined since 1981, but it still accounts for almost twice as many Btus as fuel oil. Prices declined in the mid-1980s for natural gas, but a bill removing price controls from natural gas at the wellhead by 1993 sailed through Congress in 1989. Although only about one-third of U.S. natural gas was subject to federal price controls in 1989, most of the controlled gas is selling at prices below the federal ceilings, and proponents of the bill believe that complete decontrol will lead to increased gas production, thereby mitigating any future upward pressure on prices.

Prices continued to decline for oil as well, allowing several mills to defer energy conversion or conservation projects. Obviously, oil consumption reflects changes in oil prices, so OPEC holds the cards that may reveal future consumption patterns.

Consumption of coal has expanded by about 6%/year since the mid-1970s, and this trend is expected to continue. Coal supplied 13.9% of the industry's energy needs in 1988 and ranks as its third-largest energy source.

Electricity is typically on the lower end of the energy consumption scale, accounting for 6.6% in 1988. The con-

U.S. PULP AND PAPER INDUSTRY PURCHASED ENERGY COSTS AS PERCENTAGE OF SHIPMENTS

(million $)

Year	Purchased energy costs*	Value of shipments	As percentage of shipments
1988p	4,161	57,177	7.3%
1987r	4,175	51,518	8.1
1986	4,249	43,990	9.7
1985r	4,825	39,173	12.3
1984r	5,050	41,384	12.2
1983r	4,841	36,071	13.4
1982r	4,714	34,001	13.9
1981	4,758	35,116	13.5
1980	4,026	31,758	12.7
1979	3,268	27,991	11.7
1978	2,704	24,027	11.3
1977	2,550	22,302	11.4
1976	2,194	20,976	10.5
1975	1,876	17,822	10.5
1974	1,651	18,530	8.9
1973	933	13,714	6.8
1972	805	11,705	6.9

* Includes electric energy, fuel oil, coal, natural gas, and other fossil fuels.
p = Preliminary.
r = Revised.

Sources: American Paper Institute, Bureau of the Census.

troversy over radiation generated from North American electrical power lines continued to rage in 1989. Construction was halted for a short time on a 90-mile power line that will supply Canadian Pacific Forest Products Ltd.'s Gold River, B.C., mill. British Columbia Hydro & Power Authority had attempted to quell public fear over radiation emissions by offering to buy all houses within 50 m of the edge of its right of way. An inquiry before the provincial commission in July 1989 rescinded the order to cease construction and denied a request to reroute the 230-kV line away from populated areas.

Energy consumption by grade. Newsprint made mainly from thermomechanical pulp (TMP) requires a high amount of energy per ton of production, which is supplied by purchased electricity and fossil fuels (although some woodwaste may be burned). Unbleached kraft linerboard has lower total energy requirements per ton than newsprint, and about half of the energy may come from burning black liquor. Recycled grades require considerably less total energy per ton to produce than virgin paper and paperboard, but they must rely entirely on purchased fossil fuel and electricity. Purchased-energy requirements for recycled newsprint are lower than for newsprint made from TMP; however, they are probably higher for recycled linerboard than for kraft linerboard. Thus, recycled paper and board production does not necessarily conserve energy—at least not from purchased fossil fuels and electricity.

Energy projects. The U.S. pulp and paper industry is on the way to its sixth consecutive year of record capital spending in 1989, but outlays for power plant improvements have drifted downward over the same period. Because of lower energy prices, companies have shifted their spending priorities to other areas of the mill. Projects to improve energy efficiency are not a top priority, especially during a time of record prices for pulp and paper products. After years of belt-tightening projects designed to lower costs, mills cannot resist expanding production capacity in the current environment.

According to the Commerce Dept., papermakers plan to spend a record $15.12 billion on new plants and equipment in 1989, up 34.6% from 1988. That increase follows a 25% increase in 1987. In *Pulp & Paper* magazine's fall survey of spending plans, companies reported plans to spend $13.0 billion on production-related mill projects during the 1988-90 period. Capacity expansion is the driving force behind current spending programs, and the industry has slated double-digit increases in spending for new paper machines, machine rebuilds, and pulping improvements.

In fact, the power plant is the only area of the mill in which spending was lower in 1989. Mills reported plans to spend $1.242 billion, a hair lower than the $1.355 billion reported for 1988. In percentage terms, power-plant spending declined from 18% of total outlays in the 1987 survey to just 10% in fall 1988. Energy-related project expendi-

U.S. PULP AND PAPER INDUSTRY ESTIMATED FUEL AND ENERGY USE

Source	1988 Consumption (trillion Btus)	% of total	1987 Consumption (trillion Btus)	% of total	1986 Consumption (trillion Btus)	% of total	1972 Consumption (trillion Btus)	% of total
Purchased electricity	161	6.6%	148	6.1%	147	6.4%	93	4.4%
Purchased steam	21	0.9	17	0.7	19	0.8	23	1.1
Coal	336	13.9	335	13.9	344	14.9	225	10.7
Residual fuel oil	182	7.5	160	6.6	189	8.2	447	21.2
Distillate fuel oil	10	0.4	8	0.4	8	0.3	22	1.1
Liquid propane gas	3	0.1	3	0.1	3	0.1	3	0.1
Natural gas	338	14.0	345	14.4	288	12.5	443	21.0
Other purchased energy	2	0.1	25	1.0	3	0.1	2	0.1
Energy sold	(40)	—	-(35)	—	(30)	—	(13)	—
Total purchased fossil fuel and electricity	1,011	43.5	1,006	43.2	970	43.3	1,243	59.7
Hogged fuel, 50% moisture	267	11.1	258	10.7	255	11.1	42	2.0
Bark, 50% moisture	126	5.2	135	5.6	132	5.7	95	4.5
Spent liquor, solids	944	39.2	950	39.6	901	39.2	700	33.2
Self-generated hydroelectric	12	0.5	12	0.5	9	0.4	9	0.4
Other self-generated energy	12	0.5	10	0.4	6	0.3	3	0.2
Total self-generated and waste fuels	1,360	56.5	1,364	40.3	1,303	56.7	845	40.3
Total energy	2,373	100.0	2,371	100.0	2,273	100.0	2,093	100.0

Note: Columns may not add to total due to rounding.

Source: American Paper Institute.

tures have declined steadily from a peak of 31% of total outlays in 1983.

The number of new power boilers planned through 1991 is down sharply from past years. Fifteen new power boilers have been approved for the 1989-91 period, compared with over 25 installations in the 1987-89 period and about 40 during 1985-87. In contrast to the cutback in new power boilers, the number of approvals for new recovery boilers has risen sharply as mills gear up for a major wave of kraft pulp expansion. Thirteen new recovery boiler installations are planned for 1988-91, most of them part of larger pulp mill upgrade programs.

Cogeneration. While the pulp and paper industry leads U.S. industry in cogenerated and self-generated electricity capacity, planned cogeneration projects are down from recent years. Twelve projects are planned for 1988-91, five of which were completed in 1988. By 1990, about 9,000 MW of cogeneration capacity are expected to come onstream. Two installations are on hold at Erving Paper Mills, Erving, Mass., and Federal Paper Board Co. Inc., Sprague, Conn. Erving could not get a contract to sell excess power, and Federal's project was affected by lower oil prices.

Increasingly, cogeneration projects are being undertaken not by the paper companies themselves but by independent firms or joint ventures set up to own and operate the cogeneration facility. One of the most interesting of these arrangements has been proposed for Northampton, Pa. Northampton Paperboard is a $480-million, 500-tpd recycled paperboard mill that would accompany an 82-MW, culm-fired cogeneration plant. (Culm is a coal waste product.) Wheelabrator Environmental Systems would invest in both projects, which are separate but related. Several northeastern corrugated box converters would also invest in the mill.

O'Brien Energy Systems will build and operate a 52-MW plant at the Newark Boxboard Co. in Newark, N.J., allowing the mill to retire a steam boiler. In mid-summer 1989, Energy Initiatives constructed a 65-MW facility at Marcal Paper Mills Inc.'s Elmwood Park, N.J., tissue and specialty paper mill.

ENERGY USE PER TON OF PULP, PAPER, AND BOARD PRODUCED

	1988	1987	1986	1972
Energy consumption (trillion Btus)	2,372.0	2,371.0	2,072.8	1,793.0
Total paper and board production (million tons)	76.5	74.3	75.3	54.7
Energy use/ton (million Btus)	31.0	31.9	27.5	32.8

Source: American Paper Institute.

United States:

TRANSPORTATION

Transportation in the U.S. has changed throughout the decade because of deregulation, although services for the pulp and paper industry have not shifted drastically in the last couple of years. Pulp and paper shipments essentially remain divided at about 60% rail and 40% truck. Competition among rail lines and between rail and trucking continues to increase, with rail losing some business to trucking. Rail tends to have the advantage on long-haul cargoes, whereas trucking is often better suited for short-haul deliveries and lightweight products such as sanitary tissue.

Aggressive transportation environment. In 1980, the U.S. adopted Staggers Rail Act, which substantially deregulated the rail industry and ultimately stabilized freight rates at reasonable levels. Government statistics indicate that prices posted their biggest gains in the years immediately preceding and following implementation of the act. Indeed, rates for pulp and paper products increased a hefty 20.5% from 1979 to 1980. However, rate increases began to settle down by 1983. The biggest jumps in recent years occurred in 1984 and 1988, when rates increased 4.5% and 4.0%, respectively. Selected rate increases on paper and chemicals were implemented at the beginning of 1989.

CARLOADINGS OF MAJOR U.S. RAILROADS

(000 cars loaded)

Year	Pulp, paper, and allied products	Primary forest products	Lumber and wood products	Total forest products	All rail car-loadings
1988	638	512	391	1,541	22,140
1987	647	544	419	1,610	20,812
1986	655	532	397	1,584	19,477
1985	712	584	366	1,662	19,574
1984	763	697	372	1,832	20,257
1983	778	739	368	1,885	18,800
1982	829	766	308	1,903	18,498
1981	966	939	397	2,332	21,618
1980	1,060	1,002	469	2,531	22,598
1979	1,097	1,055	597	2,749	23,876
1978	1,094	1,086	649	2,829	23,373
1977	1,103	1,112	675	2,890	23,173
1976	1,101	1,139	670	2,910	23,457

Source: Assn. of American Railroads.

The real (constant dollar) price of railroad transportation on a ton-mile basis has been reduced for all freight, according to the Assn. of American Railroads (AAR). The Staggers Rail Act encourages rail carriers to show more sensitivity to the needs of shippers. While enjoying increased financial stability, carriers have also posted significant gains in efficiency and productivity, which are then passed on to shippers because of the competitive marketplace.

The rail industry has nevertheless lost ground in the paper industry. Carloadings of pulp and paper products in the U.S. fell 1.4% in 1988 to 638,000 cars, despite an overall freight gain of 6%. The 1988 decline follows a similar drop of 1.2% in 1987 to 647,000 cars, down from 655,000 cars in 1986, according to AAR. The 1988 figure is 16.4% lower than it was in 1984. The pulp, paper, and paperboard industry is, in fact, the primary user of boxcar rail transportation, according to documents filed by the American Paper Institute with the Interstate Commerce Commission (ICC) in support of a boxcar pooling arrangement.

Carriers have targeted the pulp and paper industry for "new" services. For example, Consolidated Rail Corp. (Conrail) in 1989 introduced a service geared toward rolled paper producers making newsprint, pulpboard, groundwood paper, kraft paper, and printing paper. The service, called Paper Connection, allows buyers without rail sidings to take advantage of long-haul rail combined with just-in-time truck delivery.

Conrail has contracts with six independent distribution centers that are within 90 minutes driving time of most paper users within their markets. The distribution centers, each with rail-truck transfer and storage facilities, are located in Elizabeth and New Brunswick, N.J.; The Bronx and Syracuse, N.Y.; Harrisburg, Pa.; and Cincinnati, Ohio. Each center uses computerized inventory control management systems.

Conrail said the service can eliminate the expense of long-distance trucking for less-than-truckload shipments. Under the program, the line moves boxcar shipments from mills to the distribution centers, then ships directly by truck or stores the cargo for just-in-time shipments.

Another plan targeted at pulp and paper shippers has not moved very far. The plan, called boxcar pooling, was designed to make boxcars more readily available for shipping pulp and paper. It was approved by ICC in 1987. Pooling was supported by API and several large paper companies, along with major rail lines including Conrail, CSX Transportation, and Southern Pacific Transportation Co.

Boxcar pooling allows a central management company to coordinate use of boxcars from various railroads that might otherwise be empty on return trips. Supposedly, most of these cars are specially designed for shipping pulp and paper or similar products. Because of past inefficiencies in the system, paper companies have reduced their use of the aging boxcars by more than half, relying instead on truck, truck-trailer piggyback on rail, and intermodal container rail shipping. Double-stacking container is particularly advantageous to shippers on transcontinental routes.

Piggyback traffic, also known as trailer-on-flatcar or container-on-flatcar, has grown in popularity. It accounts for more than 15% of all rail carloadings. Piggyback traffic rose 40% from 1981 to 1985; 10% in 1986, and another 7% to 8% in 1987, according to the Dept. of Commerce.

Rail has also lost ground to waterborne shipping in certain special cases. Scott Paper Co. decided for 1990 to have both woodchips and roundwood shipped to its Mobile, Ala., mill by river barge rather than rail.

Competition strong in trucking. The U.S. trucking industry was essentially deregulated in 1985, and it has been under severe competitive pressures ever since. This level of competition has kept freight prices down while costs, such as insurance and taxes, have escalated.

One paper industry official said that two key issues affecting trucking are a shortage of qualified drivers and the ease of entry for startup companies, which then undercut established firms.

Trucking has also been fighting its image as a road menace. In 1986, truckers supported passage of the Motor Carrier Safety Act. MCSA set up guidelines that prohibited drivers from holding more than one license after July 1987, set federal standards for testing and licensing truck drivers by July 1988, established a national clearinghouse for exchange of driver information by July 1989, required states to be in full compliance by September 1993 or lose federal highway money, toughened penalties for drug and alcohol abuse on the road, and increased federal funding for more roadside inspections from $16 million to $60 million in 1991.

Ocean transportation drags anchor. Ocean-going carriers have had their own problems under deregulation. For example, by April 1989, freight rates for shipping woodpulp and kraft linerboard from the East Coast to continental Europe fell 28% and 2%, respectively, from their levels at the beginning of 1984. In addition, rates between Longview, Wash., and Japan for milk carton stock fell almost 27% during the same period. U.S. West Coast-Far East trade had been in relative balance, but in late 1989, Pacific Commerce Line, a subsidiary of FedNav Ltd. of Montreal, Que., introduced three new vessels to carry forest products on those routes. This was expected to have a disruptive effect on trade.

Early in 1989, Weyerhaeuser Co. considered selling its Westwood Shipping Line as part of the company's effort to unload certain businesses, but it has retained ownership so far.

Ocean transport represents about one-third of all U.S. waterborne shipping. It figures prominently in U.S. wastepaper exports, but overall shipments of pulp and paper have declined.

U.S. RAILROAD FREIGHT PRICE INDEX

(1984 = 100)

Year	Pulp, paper, and allied	% change from previous year
1988	104.8	4.0%
1987	100.6	-0.4
1986	101.0	1.0
1985	100.0	0.1
1984	99.9	4.5
1983	95.6	1.0
1982	94.7	10.8
1981	85.5	11.5
1980	76.7	11.6
1979	68.7	20.5
1978	57.0	5.7
1977	53.9	5.7
1976	51.0	8.3
1975	47.1	13.5
1974	41.5	15.3
1973	36.0	0.3
1972	35.9	1.4
1970	35.4	12.4
1970	31.5	9.0
1969	28.9	n.a.

n.a. = Not available.

Source: Bureau of Labor Statistics.

United States:

RESEARCH AND DEVELOPMENT SPENDING

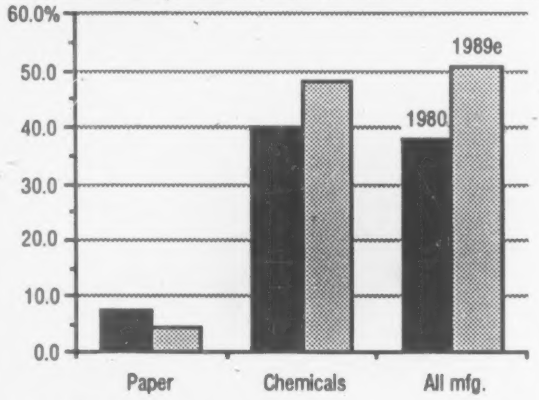
Besides the work done by paper companies, a significant amount of research into papermaking processes and technologies is performed by supplier companies as well as by universities and government agencies. Suppliers who perform a substantial amount of research work for the industry include manufacturers of papermaking equipment, felts and fabrics, computer control systems, and chemicals. Academic and government groups are particularly active in paper chemistry and forestry.

Leading research institutes specializing in paper science include the Institute of Paper Science & Technology (IPST; formerly the Institute of Paper Chemistry) in Atlanta, Ga.; the U.S. Forest Products Laboratory in Madison, Wis.; and the Pulp & Paper Research Institute of Canada (Paprican) in Pointe Claire, Que.

Typical subjects on the research agenda include forest genetics and reforestation techniques, wholetree utilization, hardwood pulping processes, water- and air-quality analysis and control, improved energy use and recovery technology, new types of wet- and dry-forming of paper, computer process control, use of chemicals and fuel from byproducts and waste, and coating and packaging technology.

By year-end 1989, IPST will have moved from Appleton, Wis., (where it has been located for over 50 years) to a new facility on the campus of Georgia Institute of Technology. IPST said the main reason for the move was the intellectual stimulation that comes with proximity to a major research facility. Georgia Tech already has a chemical engi-

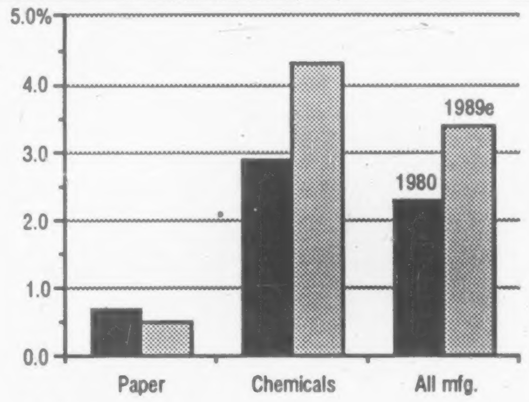
R&D SPENDING PATTERNS, AS PERCENTAGE OF CAPITAL SPENDING



e = Estimate.

Source: Data Resources Inc.

R&D SPENDING PATTERNS, AS PERCENTAGE OF SALES



e = Estimate.

Source: Data Resources Inc.

neering program with a pulp and paper option, which will be enhanced by the presence of IPST.

An IPST spokesman said mergers within the paper industry have caused the number of its dues payers to decrease. In the last couple of years, however, the percentage of pulp and paper production accounted for by its membership relative to total U.S. production has increased. City officials are now touting their own Atlanta, Ga., as the U.S. headquarters for paper industry research and development (R&D), given the fact that the Technical Assn. of the Pulp & Paper Industry is also located in Atlanta.

In order to fill the vacuum created by IPST's departure from Wisconsin, the nation's only federal Forest Products Laboratory, located at the Univ. of Wisconsin at Madison, has been inviting paper companies to tour the lab and explore the potential for joint research projects. The lab has a complete research-scale paper mill, and it is currently working on about six joint research agreements, including a project with 16 paper companies on pulping research. Such cooperative research projects were made feasible in 1986 with passage of the Technology Transfer Act, which allows federal facilities to work confidentially with companies, delaying public release of information for three to five years in most cases. The lab has a $15.5-million budget, but less than a quarter of that goes to pulp and paper research.

Another method of funding R&D is joint projects between supplier companies and research institutions. For example, Beloit Canada Ltd., Beloit Corp. of the U.S., and Paprican are working to develop a commercial high-temperature pressing system that will employ the principles of impulse drying. The project will initially focus on newsprint and other uncoated groundwood papers of less than 85 g/m².

Separately, Paprican is devoting considerable research to determine how to use more chemi-thermomechanical pulp in printing papers, tissue, and packaging grades. It is also looking into the best uses for Canada's abundant hardwood stands. In chemical pulping, Paprican said its major objective is to learn how to retain pulp strength normally lost when cooked chips are discharged from kraft digesters. Of course, it is also spending much time researching dioxin formation.

At this point in the paper industry's development, a large portion of expenditures on R&D is lumped together under the rubric of spending on environmental and consumer protection. The U.S. paper industry's National Council of the Paper Industry for Air & Stream Improvement has spent a lot of money researching how trace amounts of dioxin are formed as an unwanted byproduct of bleached kraft pulp processes. It is also paying for risk assessments in order to prove to consumers that using bleached paper products is safe.

Industry expenditures. R&D spending for the paper and allied industries totaled $611 million in 1987—a 13.6% increase over 1986 and the largest percentage increase of the major industries shown in the accompanying table, according to the National Science Foundation. (NSF revised its survey method in conducting the 1987 survey, which is why these numbers look different than those in the *1988 Factbook.*)

The paper industry lags in its ratio of R&D spending to total capital expenditures. R&D outlays came to 6.0% of capital spending in 1988, according to Data Resources Inc. (DRI), compared with 55.4% for all manufacturing. DRI says that the percentage will drop to 4.5% in 1989 for the paper industry. As a percentage of paper industry sales, R&D accounted for 0.5% in 1988, and it is expected to maintain this level in 1989. This compares with a 3.5% level in 1988 and a projected 3.4% level in 1989 for all manufacturers.

In dollar terms, DRI estimates that the paper industry spent $676 million on R&D in 1988. Spending in 1989 is projected at $721 million, rising to $726 million in 1991.

Year-to-year increases in the paper industry compare well with other groups, however. The paper industry raised R&D outlays an average of 10.7%/year between 1977 and 1986, compared with 11.5%/year for chemicals and 11.8%/year for all manufacturing.

DRI commented that industry in general is still more concerned with short-term profits than long-term opportunities. This trend is exacerbated by the fact that the tax credit for R&D has been reduced from 25% to 20% and may drop further by the end of 1989. As the paper industry enters into a period of lower profitability, it seems unlikely that 1990 will see more funds being allocated to R&D.

The Battelle forecast estimates that the U.S. paper industry will spend $1.009 billion on R&D in 1989, virtually all of

R&D SPENDING BY INDIVIDUAL PAPER COMPANIES

	1988 R&D spending (million $)	% change 1988-87	1988 R&D expenditures (as % of sales)	1988 R&D expenditures (per employee)
Kimberly-Clark	$110.90	0.0%	2.1%	$2,893.4
Scott Paper	64.90	16.0	1.4	2,403.7
Weyerhaeuser	57.50	23.0	0.6	1,223.1
Mead	53.90	18.0	1.2	2,566.7
James River	45.40	23.0	0.9	1,164.1
Union Camp	44.10	11.0	1.7	2,383.7
Westvaco	29.10	6.0	1.4	1,969.8
Boise Cascade	9.50	39.0	0.2	478.2
Consolidated Papers	5.00	8.0	0.6	1,122.6
Pentair	1.50	n.a.	0.2	172.4
Industry composite	421.70	12.0	1.0	1,767.8

n.a. = Not available.

Source: *Business Week.*

which will come from the industry itself rather than from government or nonprofit groups. This compares with a federal funding level of about 33% for R&D in all manufacturing industries. For example, the federal government funds about 25% of R&D in the primary metals industry.

Battelle forecasts that growth in R&D spending for U.S. industry as a whole will slow to 2.8%/year during the next few years, compared with an average of 3.6%/year from 1977 to 1987. Total R&D spending in the U.S. is forecast to reach $129.2 billion in 1989, a rise of 3.4% from the $124.9 billion that NSF estimated was spent in 1988. Battelle said that R&D spending is greatly affected by industrial restructuring, a renewed emphasis on short-term profits, and the weakness of the dollar, and it is less affected by uncertainties in the stock market and tax laws.

Released in mid-1989 by the federal Office of Technology Assessment (OTA), a study of 19 manufacturing corporations involved in recent mergers or acquisitions found that high debt leads to reductions in R&D, although it was not the only factor causing a drop-off in corporate R&D spending. The OTA study's conclusions were confirmed by NSF, which focused on mergers and restructurings involving the largest R&D companies and found a 5.3% reduction in R&D spending in current dollars between 1986 and 1987.

Gearing up for 1992. In the opinion of many industry leaders, U.S. pulp and paper companies are not spending enough on R&D to enable them to compete successfully against other industries or against European and Scandinavian manufacturers in their own arena. This shortcoming will become critical as 1992 approaches, when the European Community becomes the world's largest single market. U.S. tissue producers are successfully competing in Europe. In contrast, North American producers of printing/writing papers are finding that their domestic market as well as the European market are being encroached upon by producers from Nordic countries.

U.S. PAPER INDUSTRY R&D SPENDING vs OTHER MAJOR INDUSTRIES

(million $)

Industry	1983	1984	1985	1986	1987	% change 1987/86
Nonferrous metals	$302	$319	$385	$418	$442	5.7%
Stone, clay, and glass	586	705	825	942	1,014	7.6
Chemicals	6,792	7,736	8,310	8,656	9,638	11.3
Paper and pulp[1]	552	594	576	538	611	13.6
Petroleum	2,074	2,245	2,194	1,971	1,885	-4.4
Food and beverage[2]	881	1,234	1,315	1,535	1,400	-8.8
Textile mill products/apparel	150	182	218	246	227	-7.7

1. 1985 data include allied products.
2. Data from 1984 onward include tobacco.
Note: All data were revised in 1987.

Source: Div. of Science Resources Study, National Science Foundation.

United States:

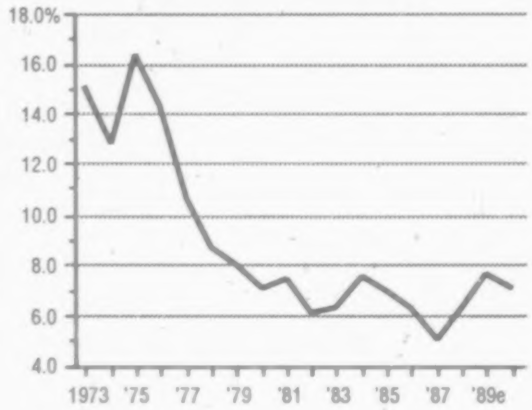
ENVIRONMENTAL SPENDING AND REGULATIONS

The U.S. pulp and paper industry embarked on a massive cleanup program in the 1970s to comply with newly passed environmental legislation. Environmental outlays claimed more than 20% of total capital spending in the early 1970s, with the percentage running to more than 30% for primary mills. Total dollar outlays peaked in 1976 as deadlines were reached under major air and water legislation. In recent years, pollution-control spending has been about 5% to 7% of the industry's total capital expenditures.

The fact that trace levels of dioxin have been found to be an unwanted byproduct of chlorine-bleached kraft pulp production is expected to significantly increase mill outlays for pollution-abatement equipment. However, environmental spending will probably never again approach the levels reached in the early 1970s. Pollution-control spending is expected to increase as 1992 approaches because most kraft pulp mills have been put on the short list of Section 304L under Clean Water Act amendments of 1987.

The annual survey of pollution-control expenditures by Data Resources Inc. (DRI)/McGraw-Hill predicts that the pulp and paper industry will step up spending by a whopping 62.8% in 1989 compared with 1988. These expendi-

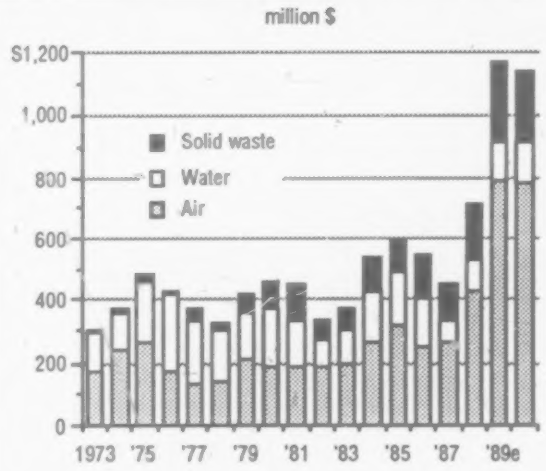
CAPITAL SPENDING FOR POLLUTION ABATEMENT, AS PERCENTAGE OF TOTAL SPENDING



e = Estimate.

Source: Dept. of Commerce; Data Resources Inc.

CAPITAL SPENDING FOR POLLUTION ABATEMENT, BREAKDOWN BY AREA



e = Estimate.

Sources: Dept. of Commerce; Data Resources Inc.

tures will amount to $1.172 million, or 7.4% of capital spending. In 1990, pollution-control spending is forecast to slip 2.4% to $1.144 million, or 7.1% of capital spending plans. For all manufacturing industries, pollution control will account for 4.0% of total capital spending in both 1989 and 1990, DRI reported. DRI also said that most of the money spent by mills during 1988-90 is going toward air-pollution-control equipment.

The Dept. of Commerce did not do a critical survey in 1987, but extrapolated from 1986 data, so there is no official estimate for pollution-control spending by the paper industry since 1986.

NEW LEGISLATION

Air. Congress failed to revise the Clean Air Act in 1988 and promised to do so in 1989. The revision brings up the thorny problem of acid rain, which is causing a widening rift between Canada and the U.S. In June 1989, President George Bush proposed legislation to amend the act. His administration's bill would cut acid rain by 50% by the year 2000. Industry would bear most of the costs of the bill, which calls for a 10-million-tpy reduction in the sulfur emissions from coal-fired power plants blamed for acid rain. The largest reductions would be required of 107 of the biggest, oldest power plants, most of them in the Midwest. The proposal also allows power plants to choose the cheapest way of making reductions, and it would set up a system of emissions trading. This would enable utilities to buy and sell credits for additional pollution reductions they make.

U.S. PAPER INDUSTRY ENVIRONMENTAL PROTECTION SPENDING

(million $)

Year	Water	Air	Solid waste	Total	% of total capital spending
1987pl	105	120	93	324	—
1986	80	109	48	237	4.0%
1985	121	175	46	342	7.0
1984	62	130	34	226	6.0
1983	118	149	60	327	6.0
1982	81	214	23	318	9.0
1981	91	120	49	260	6.0
1980	140	190	38	368	9.0
1979	178	158	23	359	12.0
1978	182	149	32	363	16.0
1977	278	148	17	443	19.0
1976	319	216	29	564	29.0
1975	286	341	18	645	30.0
1974	216	296	11	523	31.0
1973	179	162	10	351	34.0

pl = Planned.

Source: American Paper Institute's Statistics of Paper & Board.

For industry, instead of putting a per-ton limit or a percentage reduction in place, the plan would limit emissions from manufacturing facilities by requiring state-of-the-art technology to control releases of certain carcinogens and other toxic fumes. The legislation identifies about 190 toxic substances targeted for control, compared with the seven whose emissions are currently restricted. Half of the industrial processes involved would be regulated within seven years. The rest would be controlled at the discretion of the Environmental Protection Agency. This will increase the permitting requirements of pulp and paper mills as each of the listed air toxic chemicals becomes a regulated pollutant. Fines will be imposed for noncompliance.

It is estimated the bill will cost industry from $14 billion to $18 billion/year. This figure does not include rises in utility rates, which are forecast to jump 10% to 15% for mills in the Midwest that rely on coal-burning utilities.

Although the acid rain provisions primarily target emissions from the utilities industry, the first phase of the Bush proposal would require reduced sulfur dioxide emissions from many industrial electric power and steam boilers in excess of 100 MW. The second phase will affect many units larger than 75 MW.

Most observers feel that the Bush Administration, unlike that under Ronald Reagan, will push an acid rain bill through Congress. However, Congress has several acid rain bills of its own in the hopper, and it will probably take three years before a bill is passed and facilities must comply with new regulations.

Because no federal acid rain legislation was enacted under Reagan, certain states resorted to enacting their own laws to address the problem. Some states have developed research programs, while others have enacted acid deposition standards. New York, Massachusetts, and Minnesota have adopted acid rain control statutes and regulations.

EPA has not taken the initiative in regulating sulfur oxides, prompting a lawsuit by the Environmental Defense Fund. In April 1988, EPA gave notice in the *Federal Register* that it did not propose to revise the primary standards and felt it was premature to revise secondary standards due to fundamental scientific uncertainties. The upshot is that EPA is awaiting an order by a district court before it will make a formal decision whether to revise secondary standards for sulfur oxide, perhaps in early 1990, unless the district court puts an earlier deadline in place.

Water. The first bill the 100th U.S. Congress passed in 1987 was an $18-billion amendment to the Clean Water Act. The bill sets water-pollution limits through 1994 and provides funds to state and local governments for construction of secondary sewage-treatment plants. It also allocates $400 million toward controlling nonpoint source pollution, such as rainwater runoff from tree farms. More stringent new-source performance standards for discharge of certain chemicals will have the greatest effect on the pulp and paper industry.

The biggest environmental issue to dog the U.S. pulp and paper industry in years was the discovery in 1987 of low levels of dioxin in sludges from kraft pulp mills that use the chlorine bleaching process. There are 104 such mills in the U.S. An unwanted byproduct of the chlorine bleaching process—the dioxin 2,3,7,8 TCDD—has proved to be highly toxic to laboratory animals in very small amounts. Long-term effects of dioxin on people have not been fully documented. Dioxin is a lipophilic compound, meaning that it thrives in the tissues of fish and people, rather than in water.

In April 1988, EPA and the American Paper Institute signed an agreement to initiate a joint dioxin-testing program at 104 U.S. mills. Samples of sludge, wastewater, and bleached pulp were taken at mills that bleach chemical woodpulp with chlorine or chlorine derivatives. EPA reported that preliminary results from the study indicate that dioxin may be detectable in about 80% of the mills' effluents. A more thorough study is being made of 25 mills, and results are expected in early 1990.

Pulp mills can anticipate increased monitoring of their effluent by 1992. That is the year by which Section 304L of the Clean Water Act will require certain ambient water-quality standards to be met. For dioxin, the ambient water-quality standard (i.e., the maximum amount of dioxin that can be present in the receiving stream) is 0.013 ppq (parts per quadrillion). EPA has determined that this is the concentration that would result in not more than one extra case of cancer or other severe illness if 1 million people drank the water or ate fish from it. Regional offices of EPA and the states are working backward from this figure to set limits on mills' effluent.

As of late April 1989, 11 states had adopted dioxin regulations for effluent, and 15 more were in the process of doing so. According to Region 5 of EPA, Boise Cascade Corp.'s mill in International Falls, Minn., is the first mill in the U.S. to be issued a final effluent permit that contains a dioxin limit. The permit requires the mill not to exceed a daily level of 10 ppq of 2,3,7,8 TCDD in its effluent after the mill's current expansion is completed.

Mills in New England, under the jurisdiction of Region 1 of EPA, also are faced with proposed dioxin limits in their National Pollution Discharge Elimination System (NPDES) permits. These are the limits for mill effluent proposed in April 1989 (in toxic equivalents of 2,3,7,8 TCDD): Lincoln Pulp & Paper Co., Lincoln, Maine, 2.0 ppq; S.D. Warren Co., Westbrook, Maine, [illegible]5 ppq; James River Corp., Berlin, N.H., 0.4 ppq; and Georgia-Pacific Corp., Woodland, Maine, 0.3 ppq. The mills have until June 1992 to reach those numbers; until then, they must be beneath the interim level of 50 ppq.

Although these are only draft numbers, they give an indication of how stringent the permits could be in their final form. Current technology can measure only to the 10 ppq level in water. For this reason, Wisconsin's Dept. of Natural Resources will consider compliance to exist if dioxin levels are below 10 ppq. (Wisconsin is also writing proposed dioxin limits into permits.)

A spokesman for Region 1 said that the companies involved made a "very significant, well-presented reaction to the draft permits." He said the comment from James River contained a mathematical model for dioxin uptake for site-specific use, which was developed by a contractor hired by the National Council of the Paper Industry for Air &

ENVIRONMENTAL LEGISLATION AFFECTING THE PULP AND PAPER INDUSTRY SINCE 1970

1970
Air Quality Standards Act
(Clean Air Act)
(P.L. 91-604)
Water Quality Improvement Act
(P.L. 91-224)
Resource Recovery Act
(P.L. 91-512)
Occupational Safety & Health Act
(P.L. 91-596)

1972
Water Pollution Control Act Amendments
(P.L. 92-500)
Environmental Pesticide Control Act
(P.L. 92-516)

1973
Clean Air Act Amendments
(P.L. 93-15)

1974
Safe Drinking Water Act
(P.L. 93-523)
Clean Air Act Amendments
(P.L. 93-319)

1976
Toxic Substances Control Act
(P.L. 94-469)
Resource Conservation & Recovery Act
(P.L. 94-580)

1977
Clean Air Act Amendments
(P.L. 95-95)
Clean Water Act Amendments
(P.L. 95-217)

1978
Resource Conservation & Recovery
Act Amendments
(P.L. 95-509)

1980
Solid Waste Disposal Act
(P.L. 96-482)
Comprehensive Response, Compensation &
Liability Act (Superfund)
(P.L. 96-510)

1986
Superfund Law
Safe Drinking Water Act Amendments

1987
Clean Water Act Amendments

1989
Clean Air Act Amendments

Stream Improvement (NCASI). This model is reportedly able to take into account the effects of a specific mill's effluent discharge on the actual receiving stream, the kind of fish in the receiving water, the ease of fishing there, and other factors that could obviate the need to obtain low levels of the draft permits. NCASI will probably offer the model for use to member companies of API.

No federal numbers on dioxin limits have been put forth by EPA, which has until April 1990 to decide whether to promulgate regulations on dioxin, decide that dioxin does not pose an unacceptable risk, or refer the problem to another agency. This raises the question of why mills are already seeing dioxin limits in their permits if EPA has yet to decide on regulating the substance. Separately, EPA's Office of Water has said it plans to revise the best available technology guidelines by 1993 to include dioxin, furans, and possibly other chlorinated compounds.

The Food & Drug Administration is expected to use data generated by the study to begin formulating risk assessments. FDA released the results of its tests for dioxin in milk cartons in September 1989, although they were due April 1. FDA said that milk packaged in solid bleached sulfate (SBS) cartons was safe to drink during the time the industry was switching to new production methods. API said that by the end of 1990, 100% of U.S. milk carton board will have dioxin levels at or below 2 ppt (parts per trillion).

In spring 1989, the environmental group Greenpeace petitioned the U.S. Dept. of Agriculture not to use SBS cartons in the school lunch programs. So far, the U.S. has lagged Canada in setting effluent limits and in testing milk packaged in SBS cartons. (See chapter on Canadian environmental spending and regulations.)

EPA established an Interagency Task Force on Dioxin that includes FDA and the Consumer Products Safety Commission. The group will try to determine if a risk exists to consumers who use bleached paper products, based on the 104-mill study and on estimates of migration rates. It will also include an assessment, based on product-use scenarios, of technologies that could reduce dioxin exposure.

EPA is also conducting a national bioaccumulation study, which monitors the presence of 67 highly bioaccumulative pollutants in fish at 400 sites in the U.S., includ-

ENVIRONMENTAL EQUIPMENT USED IN THE NORTH AMERICAN PAPER INDUSTRY

Item	Installed cost each ($000)	Units	Installed value ($000)	Average item life (years)	Annual replacement (units)	Annual replacement cost ($000)
Aerators and aeration equipment	$361	10,000	$3,610,000	14	714	$257,754
Air-handling equipment	210	47,000	9,870,000	15	3,133	657,930
Air and water monitoring equipment	35	11,500	402,500	12	958	33,530
Bark boilers	17,660	1,200	21,192,000	24	50	883,000
Black liquor oxidation equipment	2,460	1,000	2,460,000	18	56	137,760
Chemical metering equipment	18	26,000	460,980	10	2,600	46,098
Chimneys and ducts	505	12,000	6,060,000	21	571	288,355
Clarifiers	1,625	2,200	3,575,000	23	96	156,000
Cooling towers	992	1,800	1,785,600	14	128	126,976
Conveying equipment for bark and sludge	709	2,900	2,056,100	17	171	121,239
Diffusers	340	700	238,000	20	35	11,900
Dust and ash handling equipment	2,365	3,300	7,804,500	18	183	432,795
Economizers	1,280	3,500	4,480,000	19	184	235,520
Electrostatic precipitators	7,500	2,100	15,750,000	17	123	922,500
Filtration equipment	325	4,600	1,495,000	20	230	74,750
Filter media	17	4,000	67,000	14	286	4,791
Gas scrubbers	1,215	3,300	4,009,500	16	206	250,290
Heat exchangers	1,015	15,000	15,225,000	15	1,000	1,015,000
Pumps (sludge, etc.)	35	43,500	1,522,500	12	3,625	126,875
Recovery boilers	32,850	1,500	49,275,000	22	68	2,233,800
Screening equipment and savealls	265	7,600	2,014,000	18	422	111,830
Sludge thickening equipment	325	1,450	471,250	16	91	29,575
Water treatment equipment (influent)	1,620	1,500	2,430,000	25	60	97,200
Total			$156,253,930			$8,255,468

Source: Based on 1989-90 cost data provided by BE&K Engineering Co., projected industry-wide according to data acquired in previous *Pulp & Paper* surveys of U.S. and Canadian mills.

ing the 104 mill sites. As of mid-1989, the study had found chlorinated dioxins and/or furans in fish tissue near 83 of 96 pulp and paper mills surveyed that use chlorine to bleach pulp.

At the request of the United Paperworkers International Union, the National Institute of Occupational Safety & Health plans to test mill workers to see if they are affected by dioxin exposure. This will not be an extensive study because NIOSH does not have the funds to carry out many tests. Rather, it will be a preliminary test to see if workers are being exposed and if further tests are needed. Each blood test would cost about $1,000 to $1,200. Sampling air in the mills would cost more money. Limited testing of ambient mill air started in August 1989.

Meanwhile, the Office of Technology Assessment, which works for Congress, issued a report in May 1989 entitled "Technologies for Reducing Dioxin in the Manufacture of Bleached Wood Pulp 1" The 74-page report is a good review of studies conducted so far on dioxin, and it also covers possible methods for reducing dioxin discharges. The OTA report can be ordered for $3.75 from the Government Printing Office (stock number 052-003-01154-9), Washington, D.C. 20402-9325.

OTA recognized what those in the industry have known all along: There is no silver bullet for reducing TCDD and TCDF (furan) in bleached pulp. Instead, several technologies and process modifications may be used individually or in combination:

- Extend delignification of pulp before bleaching.
- Improve brownstock washing.
- Substitute nonchlorinated bleach agents.
- Substitute chlorine dioxide for some or all chlorine.
- Apply multiple additions of chlorine in split charges instead of in a single massive charge.
- Improve chemical mixing with pulp.
- Adjust acidity of the unbleached stock before adding chlorine.
- Use cleaner oil-based defoamers.
- Remove dioxin precursors prior to chlorine addition.
- Improve secondary waste treatment and disposal.

Community-right-to-know law. Of major importance to all U.S. industry is the Superfund law passed in October 1986. In this context, the Emergency Planning & Community Right to Know Act was designed to reduce the chances of chemical accidents, such as what occurred in Bhopal, India. Some of the new regulations cover chemicals frequently used by the paper industry. The legislation defines three categories of chemicals subject to reporting or notification: extremely hazardous substances, hazardous chemicals, and toxic chemicals. Some chemicals used by the paper industry fall into the first category, including chlorine, ammonia, formaldehyde, methyl mercaptan, hydrogen sulfide, sulfur dioxide, and sulfuric acid. Companies must notify both state and local authorities of accidental spills or releases above certain limits.

By May 1987, mills had to give notification if they stored onsite more than a "threshold planning quantity" of the chemicals. These quantities are as follows: chlorine gas, 100 lb; ammonia gas, 500 lb; sulfuric acid, 1,000 lb; and formaldehyde gas, 500 lb.

The hazardous-chemical category covers a plethora of chemicals designated as such by the Occupational Safety & Health Administration's hazard communication standard. Mills had to submit material safety data sheets on each hazardous chemical to the local emergency planning commission, fire department, and state emergency-response commission by October 1987. By March 1988, mills had to submit an emergency and hazardous-chemical inventory form detailing the maximum and daily average amounts of these onsite chemicals as well as their locations.

The third category—toxic chemicals—contains over 340 categories. Paper-industry chemicals on the list include ammonia, chlorine, chlorine dioxide, chloroform, formaldehyde, polychlorinated biphenyl, sulfuric acid, and titanium dioxide. Facilities that make, process, or use these chemicals over specific levels will have to submit annually a "toxic chemical release form" to both EPA and the state. The form will detail maximum amounts of toxic chemicals present at the facility during the year, methods of treatment and disposal, and estimates of the amounts released into the air, water, and land. The first toxic chemical release form had to be submitted by July 1988.

All states have to make this data publicly available, and in the spring of 1989, local newspapers carried lists of the worst polluters in their states. EPA has computerized the information so that people with personal computers will be able to directly access the data. The Toxic Release Report datatape for 1987 includes name, location, type of business, and amount of chemical emissions annually discharged to the air, water, and land. The data is available from the National Technical Information Service, an agency of the Dept. of Commerce, at (703) 487-4650.

Proposition 65. Some states require companies to go even further in their reports. California enacted Proposition 65, which requires that a product carry a warning if it contains a chemical that could cause cancer or reproductive toxicity. A committee set up by the governor determines which chemicals require a warning label. In January 1989, 2,3,7,8 TCDD was added to the list. The referendum also requires mills and all other production facilities to post warning notices in the workplace advising workers that such chemicals are present.

The warning on products must be given if in the judgment of the producer there is some risk to the consumer. If a professional risk assessment shows that there is no significant risk, then it is not necessary to post warning signs or labels. NCASI has tested several consumer products, such as fine papers and coffee filters, and has shown that none of them pose a significant risk. In addition, API, the Fibre Box Assn., and the Paperboard Packaging Council jointly funded a risk-assessment study to ensure compliance with the proposition.

Proposition 65 has also made producers outside of California, who ship products into the state, become more cautious. Other states, such as Hawaii, Massachusetts, and Tennessee, are considering passage of similar legislation.

United States:

PAPER MACHINERY

The U.S. is the world's largest producer of paper machinery, with shipments about four times as high as the next level of producers—Canada, Finland, and Fed. Rep. Germany. On a somewhat lower level are the U.K., France, and Italy, followed by Sweden, Switzerland, Brazil, and Japan. Of this group, Japan and Brazil have shown the most rapid growth in capacity during the decade.

Manufacturers in Fed. Rep. Germany have been the dominant force in the world market during the 1980s. In 1985 alone, their exports of $644 million exceeded those of U.S., Italian, and Japanese manufacturers combined. The U.S. has maintained its hold on second place, with a share that declined from 15% in 1981 to 10% in 1985. Over the same period, Japan and Italy raised their shares of world exports to third and fourth place, respectively.

The U.S. balance of trade in paper machinery declined throughout the 1970s, culminating in the industry's first deficit in 1979. After recovering in 1980-81, the trade balance turned negative again following the recession of 1982. Exacerbated by the strong U.S. dollar, the deficit hit bottom in 1986 at $242 million.

Machinery parts and box-making machinery were the major contributors to the deficit during the 1982-86 period, according to the Commerce Dept. Over that five-year period, exports of machinery parts fell from $179 million to $169 million, while imports rose from $97 million to $197 million. This translated a surplus of $72 million into a deficit of $28 million. Box-making exports rose slightly from

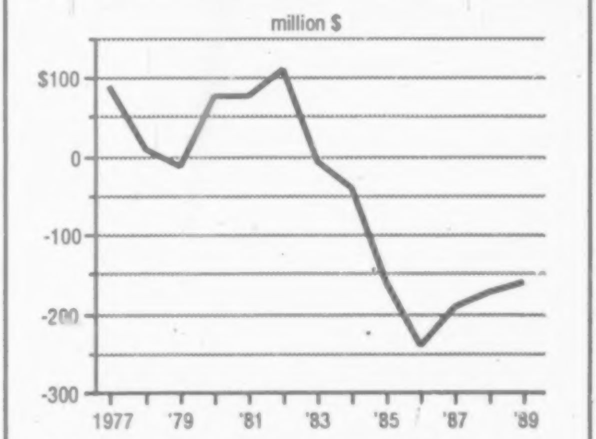
AD VALOREM TARIFFS CHARGED BY VARIOUS COUNTRIES ON IMPORTS OF PAPER AND BOARD MANUFACTURING MACHINERY

(Brussels Tariff Nomenclature 84-31)

Country	Current
U.S.[1]	Duty-free
Finland	5.10%
European Community	3.80%
Canada[2]	9.20%
Japan	
Paper	3.90%
Board	3.40%
Brazil	
If PM is made in Brazil	40.0% + 5% V.A.T.
PM not available in Brazil	20.0% + 5% V.A.T.

1. TSUS 66800.40 except for certain codes with tariffs of 2.4% (i.e., dryers and other specialized parts).
2. Tariff on U.S. machinery will be eliminated by 1993.

U.S. PAPER MACHINERY BALANCE OF TRADE



Source: U.S. Dept. of Commerce, International Trade Administration.

1982 to 1986—from $19 million to $22 million—but imports shot up from $37 million to $92 million during the same period.

Three price-related factors hindered U.S. paper machinery exporters in the early 1980s: the strong U.S. dollar, effective foreign export financing arrangements, and lower foreign production costs. Since 1985, however, the decline in the dollar and improved credit arrangements by Eximbank have strengthened the U.S. trade balance. In order to sustain competitiveness over the long term, U.S. manufacturers must invest heavily in productive capacity and in research and development, where the industry has been matched or outpaced by overseas competitors.

Outlook for 1989. The U.S. paper machinery industry is finally recovering from the battering it took after the recession of 1982. Record capital spending by pulp and paper companies at home and abroad lifted machinery shipments and trade to new highs in 1988, according to Commerce Dept. data. Domestic paper machinery manufacturers shipped products worth $1.71 billion for the year—up 19.2% from 1987 (17.0% after adjusting for inflation). The value of shipments was expected to climb another 11.2% in 1989, after inflation.

Still shaken by their experiences in the early 1980s, manufacturers have been slow to add new production capacity. Instead, they have focused on research and development and on improved service. The lack of new production capacity has led to lengthening lead times for equipment deliveries, a trend that continued throughout 1989. Employment in the industry is forecast to grow no more than 5% in 1989, so manufacturers are turning to subcontractors to handle increased demand.

Trade in papermaking machinery is quite sensitive to exchange rates, with a one- to two-year lag in their effects on trade. The strong dollar helped foreign suppliers make inroads in the U.S. market during the early 1980s; it also depressed exports of U.S. machinery. The weaker dollar of the late 1980s gave a strong boost to U.S. manufacturers' exports, and it encouraged overseas suppliers to establish bases in the U.S. as the best way to maintain their newly won market share. Foreign companies have used acquisitions, joint ventures, and licensing agreements to produce machinery in the U.S. that formerly was imported.

The U.S. will probably continue to suffer a negative trade balance in the paper machinery area for several years, particularly if the dollar continues to strengthen as it did during 1989.

U.S. machinery makers sometimes compete with their own overseas operations. Many companies, both U.S. and European, have established foreign manufacturing subsidiaries and licensees to take advantage of cheap labor, proximity to major markets, or government incentives. Such moves tend to blur the distinctions between countries of origin. Thus, a contract for a new paper machine to be installed in Canada was awarded in 1987 to the Brazilian subsidiary of a European manufacturer. And earlier in the decade, a new paper machine installed in the U.S. was supplied by the Japanese licensee of a U.S. manufacturer.

The U.S. phased out tariffs on imported pulp and paper machinery in 1987, except for a 2.4% toll on certain machine components, such as dryers and other specialized parts. U.S. suppliers are still subject to tariffs in many countries, including Finland, Canada, the European Community, Japan, and Brazil. (Canada's 9.2% tariff on U.S. paper machinery will be phased out from 1989 to 1993.)

The value of paper machinery imports climbed to a record $552 million in 1988—a gain of 10.0% over the previous year, according to the Commerce Dept. Fed. Rep. Germany was the leading source of imports, followed by Canada, Japan, Brazil, Sweden, Finland, and Italy. In 1989, imports should climb another 14% to $627 million.

U.S. exports of paper machinery also set a record in 1988, rising 23.4% to $380 million. Higher shipments to Canada were mainly responsible for the improvement, Commerce reported. Japan and the U.K. were the next largest markets. In 1989, exports were forecast to climb another 22.4% to $465 million (although the forecast does not take into account the strengthening dollar, which could have a significant impact on trade).

The Commerce Dept. forecasts 7.5% compound annual growth in the value of shipments, after inflation, for the 1989-94 period. Canada will continue to be the largest U.S. export market. The Free Trade Agreement between the U.S. and Canada provides for a phased five-year reduction in tariffs on papermaking machinery, which should help cement the relationship.

Mergers and acquisitions. In 1986, Harnischfeger Corp. purchased Beloit Corp., the largest U.S. paper machinery maker. An infusion of capital allowed Beloit to expand and modernize its facilities, and since then the compa-

CATEGORIES OF PAPER MACHINERY*

Wood preparation. Machinery involved from the receipt of rough wood at the mill yard to delivery of prepared wood or chips to the pulp mill.

Pulp manufacturing. All equipment required for processing wood or other raw fiber into pulp for delivery to stock preparation, including chemical recovery equipment.

Pulp refining. Processing of pulp fiber for delivery to the paper machine(s).

Paper and paperboard manufacturing. From the headbox through the machine winder.

Finishing. Supercalenders, winders, sheeters, and sheet and roll wrapping equipment.

Converting. Coaters, laminators, embossers, saturators, corrugators, and fabricating equipment . . . boxes, cores, bags, envelopes.

* = Based on classification scheme proposed by the Pulp & Paper Manufacturers' Assn. for use by the Bureau of Census in collecting statistical information.

ny has taken advantage of the capital spending boom in the paper industry. Beloit operates manufacturing plants in these five countries: the U.S., Canada, the U.K., Italy, and Brazil. Through its Brazilian operation, in particular, Beloit has offered government-supported financing and export incentives that make it easier to compete with other paper machine makers. Beloit also maintains licensing agreements with manufacturers in several countries, most notably Mitsubishi Heavy Industries of Japan.

Black Clawson Co., the second-largest U.S. pulp and paper machinery manufacturer, remains independent. Owned by closely held Parsons & Whittemore Inc., Black Clawson has manufacturing operations in the U.S., Canada, France, and the U.K.

Two of the top pulp machinery manufacturers were combined in 1986. Combustion Engineering Inc. purchased the Sprout-Waldron Div. of Koppers Corp. and merged it with its C-E Bauer unit, creating C-E Sprout-Bauer. In early 1987, Combustion Engineering extended its reach into the paper machinery market with the purchase of AccuRay Corp., one of the largest U.S. makers of process control equipment. Also in early 1987, Beloit formed a sales alliance with Measurex Corp., the other large process control supplier. Measurex struck a similar deal with Mitsubishi of Japan in late 1988.

Among foreign suppliers, Sunds Defibrator (a subsidiary of Svenska Cellulosa AB of Sweden) acquired Rauma-Repola Oy's chemical pulping division in 1988 for an undisclosed amount. In 1987, Sunds tried to buy the Impco Div. of Ingersoll-Rand of the U.S., but that deal fell through when the Federal Trade Commission expressed concern about the merger and Ingersoll decided not to pursue the discussions.

Early in 1986, Valmet Oy of Finland and KMW AB of Sweden formed Valmet-KMW AB to manufacture paper machinery. The company is based in Sweden and is 75% owned by Valmet and 25% owned by KMW. Valmet produces paper machines for newsprint and fine papers, while KMW manufactures tissue machines, kraft packaging paper machines, and pulp drying machines. Valmet also acquired some of Wärtsilä AB's facilities in the U.S.

In 1987, Bird Inc. of the U.S. and Sulzer Escher Wyss of Ravensburg, Fed. Rep. Germany (a unit of Sulzer Group of Switzerland), entered into a multimillion-dollar joint venture, creating Bird Escher Wyss. The venture sells pulp and paper machinery and systems of both companies in North America, and it will develop new systems for sale worldwide. In August 1989, Bird agreed to sell its 49% stake in the joint venture to Sulzer.

In May 1988, Valmet integrated Valmet-Dominion, Valmet-KMW, and Valmet-Appleton into a single North American division to improve its service to pulp and paper customers. At about the same time, Valmet was given permission by the Finnish government to sell up to 40% of its equity shares. (Valmet is state owned.) Valmet announced in October 1988 a plan to invest $100 million in its Brazilian subsidiary to diversify into making equipment for paper production and automation. Also in October, the company unveiled a joint-venture agreement with Xian Papermaking Machinery Works of People's Rep. China to manufacture paper machinery.

In early 1989, Sulzer Escher Wyss and privately held Voith discussed a possible merger, but Voith later indicated that it would remain independent.

Rebuilds vs new machines. Despite the current expansion boom under way in such grades as newsprint and

MANUFACTURERS BY COUNTRY OF NEW PAPER MACHINES STARTED UP IN U.S., 1979-88

(Number of machines)

Manufacturer	1979/80	1981/82	1983	1984	1985	1986	1987	1988	Beyond 1988	Total
Allis-Chalmers (U.S.)	—	—	—	—	—	—	—	—	—	1
Beloit (U.S.)	12	6	1	2	1	4	2	3	9	45
Black Clawson (U.S.)	—	—	—	—	—	—	—	—	—	0
Manchester (U.S.)	1	—	—	—	—	—	1	—	—	2
Dominion (Canada)	—	—	—	—	—	—	—	—	—	0
Holder (U.K.)	—	—	—	—	—	—	—	—	—	1
KMW (Sweden)	1	1	—	—	—	—	—	—	—	2
Sulzer-Escher Wyss (Fed. Rep. Germany)	—	—	—	—	1	1	—	—	2	4
Tampella (Finland)	2	3	—	—	1	—	—	—	1	8
Valmet (Finland)	1	5	1	—	—	1	—	1	7	18
Voith (Fed. Rep. Germany)	2	1	—	1	1	2	1	2	1	15
Total U.S.	13	6	1	2	1	4	3	3	9	48
Total foreign	6	10	1	1	3	4	1	3	11	48

Source: *Pulp & Paper Project Report.*

coated papers, the longer-term trend has been away from expensive new mills and machine installations and toward more cost-efficient machine rebuilds. Almost half of the paper and paperboard machines in the U.S. were installed before 1971, and 9% have been around since 1950. Black Clawson Co. and Sandy Hill Corp. have turned exclusively to the rebuild market, which is a major business for Beloit and the offshore machine makers as well. Domestic suppliers have traditionally enjoyed an advantage in the rebuild market, because most of the older machines were supplied by U.S. manufacturers.

Some 70% of machinery orders since the 1982 recession have been for rebuilds, according to the Commerce Dept. Companies rebuild their paper machines for various reasons, including capacity expansion, product-quality improvement, and grade realignment. Twin-wire retrofits—probably the most popular rebuild project—have had a strong impact on the quality of newsprint and other printing papers. In the paperboard sector, installation of high-pressure presses, such as the Beloit Extended Nip press, have kept capacity climbing during a period when few new machines are being installed.

PAPER INDUSTRY MACHINERY SHIPMENTS, EXPORTS, AND IMPORTS, 1977-89

(million $)

				Ratios	
Year	Shipments	Exports	Imports	Imports/ new supply[1]	Exports/ shipments
1989f	n.a.	465	627	n.a.	n.a.
1988e	1,710	380	552	0.244	0.222
1987	1,435	308	502	0.259	0.215
1986	1,296	269	511	0.283	0.208
1985	1,152	251	411	0.263	0.218
1984	1,130	259	301	0.210	0.229
1983	1,021	203	210	0.171	0.199
1982	1,199	316	207	0.147	0.264
1981	1,177	351	273	0.188	0.298
1980	1,177	318	242	0.171	0.270
1979	1,017	233	246	0.195	0.229
1978	799	192	184	0.187	0.240
1977	698	184	95	0.120	0.264

e = Estimate.
f = Forecast.
n.a. = Not available.
1. New supply = product shipments + imports.

Source: U.S. Dept. of Commerce, International Trade Administration.

Canada:

INDUSTRY STRUCTURE

Just under 100 corporate entities currently manufacture pulp, paper, or paperboard in Canada. These companies operate 126 paper and board mills—with or without pulp-producing capacity—and 51 market pulp mills. (Companies with combined pulp and paper capacity of 1,000 tpd or more are listed in the Company Profiles section.)

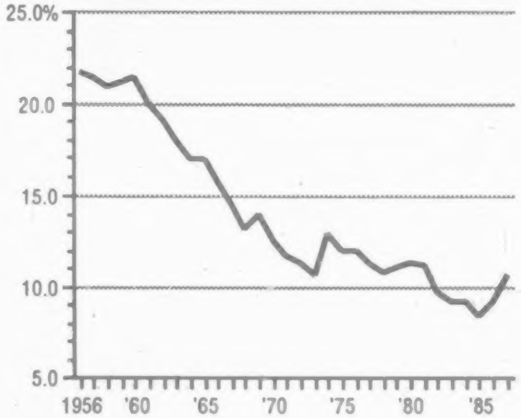
For the year 1986, a total of 142 separate establishments were listed by *Statistics Canada* in its annual "Pulp and Paper Industries" census of manufacturers, five more than the previous year. During the past 35 years, this figure has fluctuated, rising from 123 facilities in 1950 to a high of 147 facilities in 1976. The census includes those establishments primarily engaged in manufacturing pulp, paper, paperboard, and building and insulation board.

Approximately 60,400 production and related workers at these sites were counted in the 1986 census. The employees were paid wages of slightly less than C$2.2 billion.

Total industry employment for 1986 was 79,570, with wages and salaries totaling nearly C$3 billion. Pulp and paper mill workers earned an average of $697.16/week in 1985, the fifth-highest of any major Canadian industry. The next closest group was motor vehicle workers, who made $719.12/week. In 1987, pulp and paper mill employees got a 2.6% raise to $715.59/week.

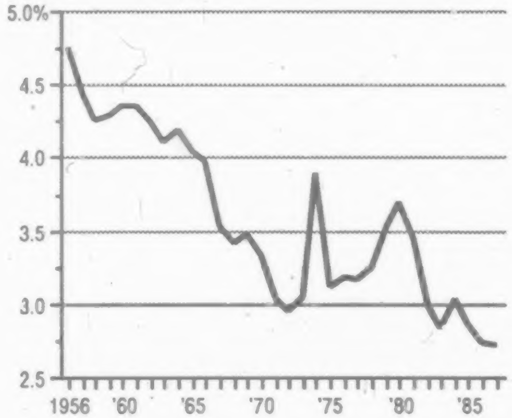
Quebec is the most significant province, in terms of number of mill sites and total output. In 1987, its mills produced 6.8 million tons of paper and paperboard (excluding building board) at 55 sites. Ontario, its closest rival with 35

SHARE OF PULP AND PAPER EXPORTS TO TOTAL CANADIAN EXPORTS



Source: Statistics Canada.

SHARE OF PULP AND PAPER PRODUCTION TO CANADIAN GNP



Source: Statistics Canada.

mill sites, had estimated production of 4.1 million tons during the same period. British Columbia ranked third, with estimated production of 2.7 million tons at 13 sites, and the total from the remaining provinces was just under 3 million tons at 23 locations.

Quebec also led in output of woodpulp in 1987, producing 7.2 million tons. British Columbia came in a close second with over 7.0 million tons, Ontario produced just under 4.4 million tons, and the remaining provinces together manufactured over 4.4 million tons.

By far, the largest segments of the Canadian industry are newsprint and woodpulp (including market pulp). Canada has historically been the world's largest producer of newsprint, with production for 1988 almost twice that of the U.S., its closest rival and largest customer. This ranking is reversed in the case of woodpulp production. As the world leader, the U.S. produces over twice as much pulp as Canada. These two commodities represented almost 76% of total estimated 1988 pulp, paper, and board shipments for the Canadian industry.

Exports, representing more than 76% of all shipments in 1988, are far more important to the Canadian industry than domestic shipments. Pulp and paper exports had been Canada's most important generator of export revenues until 1983, when they were eclipsed by the automobile industry, which remains number one. Industry dollar revenues for 1988 totaled some C$20 billion, with exports accounting for C$15 billion of that total.

The pulp and paper industry was the largest Canadian manufacturing industry in terms of gross wages and salaries paid, total employment, and value added by manufacture, according to 1985 figures (the latest available). In terms of the selling value of factory shipments, pulp and paper was third behind the petroleum and auto industries.

Pulp and paper as well as other forest products make an enormous contribution to Canada's balance of trade. In

PULP, PAPER, AND BOARD MILLS IN CANADA

(Number of mill sites)*

	Paper/ board mills[1]	Pulp mills
Alberta	3	4
British Columbia	13	34
Manitoba	4	5
New Brunswick	7	14
Newfoundland	3	5
Nova Scotia	4	8
Ontario	35	37
Quebec	55	69
Saskatchewan	2	1
Total	126	177

* One or more pulp mills may be located at the site of a paper/paperboard mill. Total pulp mills shown.

1. Molded pulp products not included in tabulations.

Source: *1989 Lockwood-Post's Directory.*

LEADING CANADIAN FIRMS

(Canadian companies ranked among the top 150 worldwide in paper industry sales)

World rank	Company	1988 paper industry sales* ($ million)	% change 1988/87	% of total sales from paper industry operations	1988 production (000 metric tpy) Market pulp	Paper/ board	Converted products
19	Noranda Forest Inc.	$2,364.5	10.8%	61.7%	1,208	2,493	—
20	Canadian-Pacific Forest Products Ltd.	2,154.2	10.9	88.2	933	396	—
33	Consolidated-Bathurst Inc.	1,490.7	5.4	77.3	335	1,065	—
34	MacMillan Bloedel Ltd.	1,472.8	9.8	55.4	480	699	268
36	Abitibi-Price Inc.	1,462.6	5.9	54.5	—	2,451	—
41	Domtar Inc.	1,374.0	11.4	62.6	275	1,220	—
73	E.B. Eddy Forest Products Ltd.	585.6	22.3	91.4	374	327	69
84	Donohue Inc.	526.8	27.1	100.0	300	521	—
88	Quebec & Ontario Paper Co. Ltd.	447.9	10.0	94.3	—	732	—
94	Cascades Inc.	397.3	6.3	83.0	118	630	—
98	Rolland Inc.	361.8	14.8	100.0	—	143	—
102	Canfor Corp.	336.8	-13.8	38.2	455	101	—
137	Eurocan Pulp & Paper Ltd.	197.5	8.5	63.8	—	361	—

* = Sales from pulp, paper, and converting operations only.
n.a. = Not available.

Source: *Pulp & Paper International.*

1987, Canada exported forest products valued at C$20.3 billion and imported $2 billion worth for a net contribution of $18.3 billion—larger than that made by mining, petroleum, fisheries, and agriculture combined. Of this amount, pulp and paper contributed a net $12.2 billion to Canada's balance of trade, which was $2 billion more than the entire national net merchandise trade surplus in 1986.

The Canadian government has sought to ensure that its pulp and paper industry remains competitive on a global scale by intervening in such key areas as trade agreements, forestry policies, and investment opportunities.

In recent years, various forestry practices have evolved to ensure adequate pulpwood supplies in the future. For example, joint industry-provincial government forest management agreements established a framework for companies to harvest Crown-owned timberlands. Tree seedlings planted in Canada have grown from 245 million in 1980 to over 800 million in 1988.

The outlook for world consumption of paper and board is bright, with projections for the year 2000 amounting to three times the current size of the entire Canadian paper and board industry. Canadian mills have some competitive advantages in certain market niches. In addition, the dismantling of trade barriers after passage of the Canada-U.S. Free Trade Agreement and the General Agreement on Tariffs and Trade gives a further boost to Canadian exporters.

Canada is likely to remain the world's largest pulp exporter, with projected expansions amounting to an annual capacity growth rate of 2.8% between 1988 and 1990. Although Canada's world market share in newsprint has been easing downward for several years, its capacity in this sector will grow about 4.7%/year between 1988 and 1991.

Despite the pulp and paper industry's outstanding performance relative to other industries, its importance to the Canadian economy in general and to Canadian exports in particular has fallen over the last 35 years. Pulp and paper production in 1987 represented just 2.7% of the gross national product, down from 5.3% in 1950. Industry exports as a percentage of foreign trade dropped even more significantly, falling from 22.9% in 1950 to a low of 8.4% in 1985. However, the ratio moved up to 9.3% in 1986, followed by another jump to 10.5% in 1987.

TEN LEADING CANADIAN MANUFACTURING INDUSTRIES, 1985*

	Number of employees	Wages, salaries (C$000)	Selling value of shipments (C$000)
Pulp and paper mills	57,444	C$2,012,841	C$12,752,049
Motor vehicle industry	13,256	366,542	3,808,885
Sawmills, shingle, and planing	49,616	1,385,418	6,642,725
Other machinery/equipment	21,443	749,993	4,595,599
Primary steel industries	37,464	1,164,247	7,347,294
Motor vehicle industry	44,354	1,555,182	23,722,616
Meat and poultry products	24,099	569,460	8,848,451
Commercial printing industries	39,047	918,672	3,701,555
Industrial chemicals industries	5,982	234,132	4,708,888
Refined petroleum products	5,545	241,440	23,770,745

* Latest available.

Source: *Statistics Canada.*

Canada:

PRODUCTION, EXPORTS, AND IMPORTS

Production at Canadian mills began to recover in 1983 from the off-years of 1980-82, and that rebound continued strongly for most grades in 1984. After more weakness—although not a downturn—in 1985, production picked up again in 1986. This upturn lasted through 1988, with new records set each year. By 1989, market conditions in some sectors began to soften.

The Canadian industry produced just under 13.5 million metric tons of paper and board in 1979 and about 100,000 tons less in 1980. Output topped 13.6 million tons in 1981, only to tumble by over one million tons the next year. In 1983, production returned to almost the 1980 level, capping the year at 13.4 million tons.

In 1983, output showed the first signs of a recovery that would boost production to 14.2 million tons by the end of 1984. In the two years that followed, levels moved up even higher. At year-end 1986, the Canadian industry had reason for jubilation as production set an all-time record of just over 15 million tons, a 5.5% increase from the previous year. That growth continued in 1987 with a 5% increase to over 16 million tons, followed by a 4% boost in 1988 to a new high of more than 16.6 million tons.

Newsprint on a roll. The recovery in Canada's important newsprint sector began in 1983; allowing for a slight correction in 1985, it has mirrored the rise in the rest of the paper and board industry. The greatest growth in year-to-year levels occurred from 1983 to 1984, when production expanded by 6.2%. This performance was not repeated during the next year, however, when production declined 0.3% from the record levels of 1984 due to softer markets and the strong U.S. dollar. From 1985 to 1986, the trend reversed again as newsprint production posted a 3.2% gain, finishing the year at almost 9.3 million tons. In 1987, a 4% increase brought output to nearly 9.7 million tons, followed by another 3% boost in 1988 to about the 10-million-ton mark.

Operating rates for the newsprint industry have been steadily climbing since their slump in 1982-83, breaking the 90% barrier in 1984 and 1985. The upturn continued

CANADIAN PRODUCTION OF PULP AND PAPER/PAPERBOARD BY PROVINCE, 1987

(000 metric tons)

Pulp		Paper/paperboard*	
1. Quebec	7,208	1. Quebec	6,792
2. British Columbia	7,035	2. Ontario	4,135
3. Ontario	4,372	3. British Columbia	2,750
4. Others	4,420	4. Others	2,369

* Excludes building board.

Source: Canadian Pulp & Paper Assn. estimates.

CANADIAN DOLLAR VALUE IN U.S. DOLLARS

(average for year)

Year	C$ = US$	Year	C$ = US$
1989*	0.838	1980	0.855
1988	0.812	1979	0.854
1987	0.754	1978	0.877
1986	0.720	1977	0.938
1985	0.733	1976	1.014
1984	0.733	1975	0.982
1983	0.812	1974	1.022
1982	0.811	1973	1.000
1981	0.834	1972	1.000

* = Through first nine months.

Sources: *Pulp & Paper Pricebook*; *Pulp & Paper Week*.

with a rates of 94% in 1986, 97% in 1987, and 98% in 1988.

At the beginning of 1989, newsprint mills sold about as much as they could make, especially because capital spending levels required equipment downtime. Additional capacity coming online during 1989-91 was expected to lower operating rates to less than 90%, according to estimates.

Newsprint's companion—uncoated groundwood specialty grades—have increased in output every year since 1979, with old newsprint machines being converted to produce the more profitable groundwood grades. Production jumped 19.7% from 1983 to 1984, 14.6% from 1984 to 1985, 15% from 1985 to 1986, and 11.3% from 1986 to 1987. Groundwood machines produced more than 1.3 million tons of paper in 1987 and approached 1.5 million tons in 1988, compared with just over 600,000 tons at the beginning of the decade.

The book and writing papers segment also regained ground lost in the recession years of the early 1980s. Production increased 6.4% from 1984 to 1985, compared with 6.8% from 1983 to 1984. A 7.9% increase in 1986 brought levels up to almost 1.2 million tons, and another 10% boost in 1987 moved this sector to nearly 1.3 million tons. In 1988, production rose about 100,000 tons, topping 1.4 millions tons.

Tissue production jumped 12% from 1984 to 1985, but the growth rate slowed to 4.0% in 1986, bringing output up to 465,000 tons. This level remained about the same in 1987 before climbing 7% to 488,000 tons in 1988.

CANADIAN PAPER AND PAPERBOARD PRODUCTION BY MAJOR GRADES, 1979-88

(000 metric tons)

PAPER

Year	Newsprint	Groundwood printing, specialties	Book and writing	Kraft papers	Tissue, special papers	Total paper	Operating rates	
							Newsprint	Other papers
1988	9,969	1,489	1,424	568	488	13,938	99%	94%
% change year ago	3.1%	9.6%	9.8%	0.2%	7.0%	4.4%		
1987	9,669	1,359	1,297	567	456	13,348	98	93
1986	9,288	1,221	1,179	541	459	12,688	94	100
1985	8,988	1,050	1,093	487	447	12,065	92	97
1984	9,013	916	1,027	430	399	11,785	92	94
1983	8,486	765	961	472	385	11,069	85	88
1982	8,117	649	831	453	375	10,425	82	82
1981	8,946	645	787	490	388	11,256	94	83
1980	8,625	614	895	533	377	11,044	94	88
1979	8,709	611	914	588	381	11,203	97	99

PAPERBOARD

Year	Containerboard			Boxboard	Total paperboard	Total paper and paperboard	Operating rate, paperboard
	Total	Linerboard	Corrugating medium				
1988	1,977	1,267	710	723	2,700	16,638	97%
% change year ago	1.1%	1.0%	1.3%	-2.6%	0.1%	3.7%	
1987	1,955	1,255	701	742	2,697	16,045	100
1986	1,847	1,199	648	726	2,573	15,261	97
1985	1,677	1,126	551	697	2,374	14,439	89
1984	1,695	1,087	608	745	2,440	14,225	92
1983	1,573	1,022	551	711	2,284	13,353	88
1982	1,365	887	478	618	1,983	12,408	74
1981	1,646	1,088	558	701	2,347	13,603	89
1980	1,671	1,175	496	673	2,344	13,388	95
1979	1,541	1,075	466	742	2,283	13,486	91

Source: Canadian Pulp & Paper Assn.

Kraft paper production dropped steadily in the early

1980s, briefly rising by about 4% in 1983 but dropping again by 8.9% in 1984. A rally began in 1985 as production increased by just over 13%. This was followed by another jump of 10.9% to 540,000 tons in 1986 and by further growth of 4.8% to 567,000 tons in 1987. Output increased by another 1,000 tons in 1988.

Paperboard ups and downs. While kraft paper performed badly in the early 1980s, containerboard was on a roller coaster ride. Output rose in 1980, fell modestly the next year, and tumbled by 13.3% in 1982, only to bounce back by the same amount in 1983. In 1984, a record 1.69 million tons was produced, up 7.8% from the previous year. As with other grades, 1985 figures could not stand up to those 1984 records, and levels dropped by just over 1% to finish the year at 1.68 million tons. A strong turnaround in 1986, with an increase of 10.1%, boosted production to almost 1.85 million tons. This was followed in 1987 by a 5.8% jump to 1.9 million tons, where it remained in 1988.

Boxboard production zigzagged during the entire decade, dropping in 1980, rising in 1981, falling the next year, and bouncing back in 1983. The rising trend continued into 1984 before reversing course and dropping 6.4% in 1985. Still on a seesaw, output figures rose 4.2% in 1986 to finish the year at 726,000 tons. Production rose again in 1987 by a modest 2.2% to 742,000 tons. In 1988, the cycle changed once again when output fell by 2.7% to 724,000 tons.

Pulp posts steady gains. The Canadian woodpulp industry, which shares top billing with the newsprint sector, has steadily increased production since the nearly 12% slump between 1981 and 1982. Increased worldwide demand and currency valuations favorable to Canadian producers have contributed to the strength in market pulp exports, while healthy demand for paper and board products has kept up production for internal use. Concern with pulpwood supplies and interest in recycling are becoming important factors in determining future pulp production.

Market pulp output was basically flat in 1988, totaling 7.228 million metric tons, compared with 7.202 million tons a year earlier. Total woodpulp production, however, was up 2.3% to 23.4 million tons. Dissolving and special alpha was the leading sector with over a 10% increase. In the paper-grade pulp segment, the biggest hike—6.2%—was recorded in bleached hardwood kraft. The largest segments, bleached softwood kraft and mechanical pulp, posted increases of 1.2% and 5.0%, respectively. Operating rates for chemical paper-grade pulp mills—half of the total industry—jumped from 87% in 1984 and 1985 to 92% in 1986 and 96% in 1987. Strikes at three eastern Canadian mills contributed to a lower operating rate of 95% in 1988.

EXPORTS REACH RECORD LEVELS

Canada is the world's largest exporter of pulp and paper, accounting for almost one-third of all international trade in those products. As would be expected, newsprint and market pulp are the largest export groups, mirroring their leading positions in overall production. In 1988, total exports reached a record level of 11.4 million tons, 4.8% higher than in 1987. Canadian products benefited on the world market from weakness in the Canadian and U.S. dollars.

Export tonnage of most grades of paper and paperboard improved in 1988, though not as significantly as the double-digit advances of the previous two years. Stronger North American currencies in late 1988/early 1989 somewhat reduced producers' competitive position. Exports of newsprint and containerboard were virtually flat, and boxboard dropped by 15%. Containerboard's slight 0.4% dip was the result of a 2.3% rise in corrugating medium exports

CANADIAN PAPER AND PAPERBOARD EXPORTS BY MAJOR GRADES, 1979-88

(000 metric tons)

						Containerboard				
Year	Newsprint	Groundwood printing	Book, writing	Kraft papers	Tissue	Total	Linerboard	Corrugating medium	Boxboard	Total paper/ paperboard
1988	8,641	1,254	500	337	78	542	316	224	68	11,418
% change year ago	0.8%	10.1%	15.7%	5.3%	21.9%	-0.4%	-2.8%	2.3%	-15.0%	2.4%
1987	8,574	1,139	432	320	64	544	325	219	80	11,153
1986	8,180	1,032	311	300	61	529	329	200	66	10,479
1985	7,964	900	278	237	56	422	280	143	61	9,919
1984	7,949	767	252	192	38	475	267	207	76	9,748
1983	7,469	636	239	234	24	461	268	193	57	9,120
1982	7,139	546	174	218	24	356	220	136	28	8,485
1981	7,871	524	127	207	26	400	256	114	40	9,165
1980	7,642	517	201	241	24	458	346	112	38	9,121
1979	7,783	486	204	240	33	350	254	96	64	9,160

Source: Canadian Pulp & Paper Assn.

that was more than offset by a 2.7% decline in linerboard.

The biggest export growth in 1988 was posted by book/writing papers, which shot up by nearly 16%. Multiwall exports were almost as active, increasing about 15% in 1988.

Exports of groundwood printing/specialty grades rose by over 10%. This sector, in general, has been strong since the beginning of the decade, as Canadian companies increased their capacity in response to market conditions. In newsprint, however, the Canadians have gradually lost market share in the global marketplace.

Woodpulp exports rose just 1.1% in 1988, ending the year at 8.16 million tons. The volume leader in the group continued to be bleached softwood kraft pulp, although growth was a paltry 1.1% to 5.8 million tons. These gains were particularly lean compared with the prevous two years, when total woodpulp exports climbed 4.9% in 1987 and 9.5% in 1986 (the year mechanical pulp exports soared 25.7%).

Western Europe regains prominence. The U.S. continues to be the most significant market for the important Canadian exports of newsprint and market pulp. However, exports to European Economic Community countries in western Europe, after declining during the 1982-85 period, showed healthy increases during 1986-88 due to the Canadian dollar's position against European currencies.

In 1986, newsprint exports to this region (excluding the U.K.) increased 136.5% to 175,000 tons, and woodpulp exports increased by a less astounding 17.7% to 1.7 million tons. In 1987, newsprint exports rose a healthy 23.4% to 214,000 tons, while woodpulp exports remained relatively flat, moving up just under 1% to 1.8 million tons. By 1988, the momentum in shipments of newsprint to this region had eased slightly, posting a 7% gain to 229,000 tons. Pulp exports picked up 4.5% to 1.9 million tons.

In 1988, Asia became the largest market for Canadian newsprint after the U.S., easing Latin America out of sec-

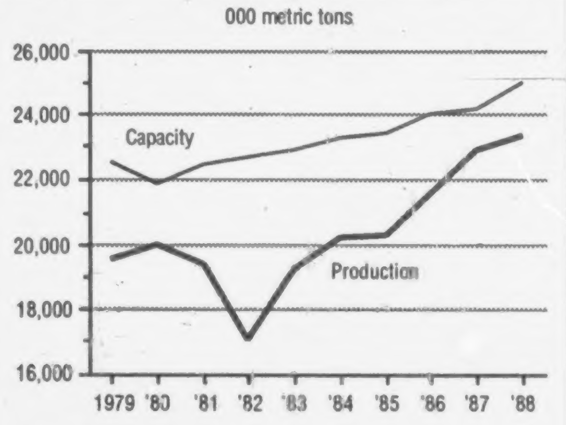
CANADIAN NEWSPRINT EXPORTS BY DESTINATION, 1979-88

(000 metric tons)

Year	U.S.	U.K.	Other western Europe	Latin America	Asia	Other countries	Total
1988	7,087	353	229	393	434	145	8,641
% change year ago	0.0%	8.0%	7.0%	-6.4%	11.9%	5.1%	0.8%
1987	7,087	327	214	420	388	138	8,574
1986	6,734	293	175	416	354	208	8,180
1985	6,674	274	74	327	455	159	7,963
1984	6,586	376	143	357	355	132	7,949
1983	6,033	502	163	428	246	97	7,469
1982	5,614	541	170	471	240	103	7,139
1981	6,062	541	189	625	356	98	7,871
1980	6,117	442	181	518	267	116	7,641
1979	6,347	398	187	445	247	159	7,783

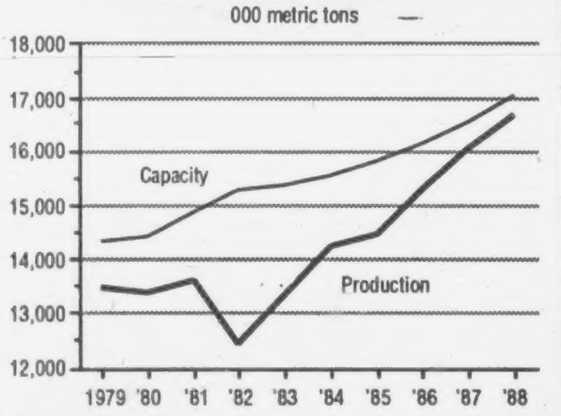
Source: Canadian Pulp & Paper Assn.

TOTAL PULP PRODUCTION VS CAPACITY



Source: Statistics Canada.

TOTAL PAPER AND PAPERBOARD PRODUCTION VS CAPACITY



Source: Statistics Canada.

ond position. Exports to Asia during 1988 reached approximately 434,000 tons—an increase of 11.9%. This followed a healthy jump of 27.2% in 1987 and a 1.4% advance in 1985.

Latin America's potential as a leading customer of Canadian newsprint suppliers is undependable. Export levels to that region had been rising in recent years, but they began declining again in 1988, dropping 6.4% to 393,000 tons. During the previous two years, demand appeared to be on an upswing after a five-year downturn between 1981 and 1986, when shipments plunged from 625,000 tons in 1981 to 327,000 tons in 1985.

Japan has become an increasingly important consumer of Canadian woodpulp. Exports to that country rose 15.5% to 911,000 tons in 1986, 12.6% to 1.03 million tons in 1987, and 5.7% to 1.09 million tons in 1988. Exports to Japan have increased more than 52.1% overall since 1981. Exports to "other countries," including the rest of Asia and Africa, are the next most important market, with 956 million tons shipped to these regions during 1988. These exports have more than doubled since 1981.

Because the major focus in the Canadian pulp and paper industry is on production for export as well as for domestic use, imports have never played a significant role in the total picture. Compared with the over 24.2 million tons of pulp, paper, and paperboard shipped out of Canada in 1987, imports during that year totaled about 1.5 million tons. Woodpulp imports for 1987, according to preliminary estimates, were an even less significant part of the whole trade picture, reaching 199,000 tons at year-end.

CANADIAN WOODPULP PRODUCTION BY MAJOR GRADES, 1979-88

(000 metric tons)

Year	Bleached sulfite	Un-bleached sulfite	Total sulfite	Bleached softwood sulfate	Bleached hardwood sulfate	Semi-bleached sulfate	Total bleached and semi-bleached sulfate	Total white pulps	Un-bleached sulfate	Total chemical paper-grade
1988	441	1,294	1,735	6,968	1,406	1,105	9,479	11,214	1,425	12,639
% change year ago	-2.9%	-0.2%	-0.9%	1.2%	6.2%	-5.5%	1.1%	0.8%	-3.3%	0.3%
1987	454	1,296	1,750	6,887	1,324	1,169	9,380	11,130	1,474	12,604
1986	428	1,248	1,676	6,324	1,299	1,187	8,810	10,486	1,410	11,896
1985	329	1,269	1,598	5,873	1,174	1,170	8,217	9,815	1,383	11,198
1984	366	1,405	1,771	5,568	1,214	1,065	7,847	9,618	1,468	11,086
1983	305	1,353	1,658	5,705	1,035	1,022	7,762	9,420	1,486	10,906
1982	281	1,444	1,725	5,098	817	921	6,836	8,561	1,142	9,703
1981	430	1,819	2,249	5,443	812	1,057	7,312	9,561	1,497	11,058
1980	405	1,763	2,168	5,922	832	1,182	7,936	10,104	1,688	11,792
1979	407	1,833	2,240	5,559	818	1,104	7,481	9,721	1,690	11,411

Year	Total chemical paper-grade	Semi-chemical	Mechanical	Screenings	Total paper-grade	Dissolving and special alpha	Total woodpulp	Operating rate
1988	12,639	335	10,112	16	23,102	267	23,369	95%
% change year ago	0.3%	-5.1%	5.0%	-5.9%	2.2%	10.8%	2.3%	
1987	12,604	353	9,629	17	22,603	241	22,844	96
1986	11,896	321	9,067	19	21,304	223	21,527	92
1985	11,198	258	8,542	17	20,015	222	20,237	87
1984	11,086	331	8,513	17	19,948	221	20,169	87
1983	10,906	305	7,778	15	19,004	217	19,221	86
1982	9,703	252	6,815	17	15,787	220	17,007	76
1981	11,058	322	7,631	19	19,030	274	19,304	86
1980	11,792	333	7,706	26	19,657	311	19,970	95
1979	11,411	323	7,388	26	19,418	368	19,516	90

Source: Canadian Pulp & Paper Assn.

CANADIAN WOODPULP SHIPMENTS[1] BY MAJOR GRADES, 1979-88

(000 metric tons)

Year	Bleached sulfite	Unbleached sulfite	Bleached softwood sulfate	Bleached hardwood sulfate	Semi-bleached sulfate	Unbleached sulfate	Total chemical paper-grade	Mechanical	Dissolving and special alpha	Total wood-pulp
1988	421	47	6,364	926	437	104	8,299	553	268	9,120
% change year ago	-3.7%	-2.1%	0.7%	1.6%	-8.2%	-12.6%	-0.1%	13.3%	10.3%	0.9%
1987	437	48	6,317	911	476	119	8,308	488	243	9,039
1986	412	51	5,860	846	529	133	7,831	469	239	8,539
1985	329	52	5,357	819	506	158	7,221	384	216	7,821
1984	330	60	5,021	877	436	161	6,885	464	221	7,570
1983	296	61	5,332	745	418	191	7,043	317	209	7,569
1982	275	76	4,515	537	356	181	5,940	273	227	6,440
1981	387	105	4,979	602	485	226	6,784	284	271	7,339
1980	392	122	5,381	592	579	232	7,298	322	310	7,930
1979	406	111	5,096	558	531	264	6,966	109	371	7,446

1. Excluding pulp sent to integrated and affiliated mills inside Canada.

Source: Canadian Pulp & Paper Assn.

CANADIAN WOODPULP EXPORTS BY DESTINATION, 1979-88

(000 metric tons)

Year	U.S.	U.K.	Other western Europe	Latin America	Japan	Other countries	Total
1988	3,686	398	1,886	144	1,086	956	8,156
% change year ago	2.9%	0.8%	4.5%	-29.4%	5.7%	-9.1%	1.1%
1987	3,582	395	1,804	204	1,027	1,052	8,064
1986	3,530	433	1,745	189	911	875	7,683
1985	3,408	321	1,483	155	789	852	7,008
1984	3,426	385	1,391	146	708	643	6,699
1983	3,289	272	1,594	101	744	795	6,795
1982	2,857	269	1,431	65	682	520	5,824
1981	3,250	326	1,667	96	692	568	6,599
1980	3,433	377	1,794	142	885	564	7,195
1979	3,577	408	1,606	86	689	416	6,782

Source: Canadian Pulp & Paper Assn.

Canada:

PRICES

Canada's pulp and paper industry serves export markets far more than it serves the domestic market, and the industry's export products are generally priced in U.S. dollars. This was a significant blessing for the industry in the early 1980s, due to the Canadian dollar's drop from approximate parity with the U.S. dollar in 1977 to below US75¢ in 1985. Between 1986 and mid-1989, Canadian currency moved up to about US84¢, making the near-term outlook bleaker.

That rise has meant unexpected losses for export-oriented companies—as much as 50% to 100% of many companies' income. In a decade of increasing global competition within the pulp and paper business, Canada's strengthening currency has blunted the edge that producers enjoyed earlier in the 1980s.

As the Canadian dollar advanced in 1987 and 1988, Canadian newsprint producers gained less from price increases than their counterparts in the U.S. The U.S. meets 58% of its newsprint requirements with Canadian supplies. As markets for many of the industry's products leveled off in 1989, profit margins were squeezed by stagnant to declining prices and unfavorable currency exchange rates.

Earlier in the 1980s, during the last downturn in newsprint markets, eastern Canadian mills made money on sales to the U.S. because of a favorable dollar differential. In fact, many of British Columbia's mills might not have remained in business through this downturn without the weak Canadian dollar. It will be more difficult for the Canadian industry as currencies swing the other way and as competition for newsprint customers intensifies due to oncoming capacity into the early 1990s.

EXPORT GRADES STRONGEST

Pulp prices performed dismally for Canadian producers during the first half of the 1980s, but boom conditions from 1986 through 1988 helped ease the sting. Bleached kraft export prices rose an average of 8.4% annually from 1976 to 1980, but during the 1981-85 period, prices declined 0.1%/year, or 10.2% for the five-year period. Bleached sulfite and unbleached kraft were hit just as hard. After dropping 15% in 1985, however, bleached sulfate pulp export prices jumped 13% in 1986, 25% in 1987, and an estimated 20% in 1988.

Thanks to their weaker currency, Canadian producers were not hit as hard as their U.S. counterparts during the down years. Between 1977 and 1986, the price of northern bleached softwood kraft (NBSK) in U.S. dollars rose about 25% in northern Europe and 22% in the U.S. The increase in Canadian dollars was 66% in Europe and 62% in the U.S. As the U.S. dollar began to weaken in 1985, Canadian currency dropped as well, maintaining the country's cushion. In the last quarter of 1986, the Canadian dollar bottomed out against the U.S. dollar at US72¢. The differential narrowed to US76¢ by the end of 1987, topped the US80¢ mark in the first quarter of 1988, and continued moving upward to US84¢ by mid-1989.

In the second quarter of 1980, the price of Canadian NBSK pulp exported to Europe hit a previous all-time high of US$545/metric ton, c.i.f. northern Europe. In the first quarter of 1982, producers attempted to raise the benchmark price by $35. Not only did they fail, but the soon-evident worldwide recession drove pricing backward. By August 1982, list quotes were down to the late-1979 level of US$465—only $30 above the previous peak achieved in early 1975. By the first quarter of 1983, they had fallen still further to just US$410, with spot-market quotes below that readily available.

A shutdown of most British Columbian mills caused by a labor dispute firmed up markets in early 1984, sparking a price recovery to US$540/ton for NBSK in Europe. But overcapacity and the very strong U.S. dollar combined to again knock down market pulp prices. By the end of 1984, NBSK sold in northern Europe for around US$470 to $480, and prices plummeted to the US$390 level in early 1985.

After the U.S. dollar weakened and markets strengthened in late 1985, producers pushed through four consecutive quarterly price hikes in 1986, bringing NBSK back to US$520/ton. The declining U.S. dollar against other major worldwide currencies benefited U.S. and Canadian producers alike, reversing the cost advantage of Scandinavian competitors and making price increases easy for overseas customers to absorb.

Producers followed their 1986 successes with price increases in each of the eight quarters of 1987 and 1988 and in the first quarter of 1989. These hikes raised NBSK in Europe to US$810/ton by early 1989, a new record high. The increase was held to $800 in the U.S. Because the U.S. dollar had strengthened against other major global currencies, the $10/ton difference between U.S. and European prices in 1989 was narrower than a $25/ton gap reflected in 1988 prices.

Prospects were dim for more increases later in 1989, as oncoming capacity additions eroded some sectors of the marketplace. Only softwood pulp remained in tight supply, and NBSK producers implemented second-quarter price increases of US$30/metric ton. Hardwood price increases slated for the same time faltered, however.

NEWSPRINT

Newsprint prices fared much better than pulp prices during the early 1980s. Export prices climbed an average of 6.7%/year between 1981 and 1985, with only one year of decline in 1982. That performance was still down compared to the late 1970s, when prices climbed an average of 11.9%/year.

Canadian mills selling newsprint in the U.S. for US$500/metric ton tried raising their prices $25/ton in March, April, and June of 1982. Each time, a sizable group of small and large producers undercut the leaders' price hikes, preferring to maintain operating rates rather than support the increase.

Mills were still trying to raise prices in the fourth quarter of 1982 when widespread discounting forced them to reverse direction and actually cut their list prices to US$468.50/ton. It was not until the third quarter of 1983 that they got the list back up to the previous level east of the Rockies. (Starting in July 1982, western producers offered contract customers 5% discounts from list price levels.) Prices did not finally break the US$500/ton level until July 1984, when eastern mills went up to $535; however, discounting of this price continued through the year and into 1985.

Producers failed to raise prices seven times in 1985, as soft demand continued and as imports of cheap offshore paper increased. Gradually improving demand in 1986 finally firmed up markets to allow a price hike in October, bringing the list price to US$570/ton. However, most tonnage was still sold in the $530-to-$550 range, and the increase was not implemented fully until early 1987. Markets remained strong in 1987, and producers were able to increase prices on July 1 and again on Jan. 1, 1988. The July 1987 increase brought the list price up to US$610/ton in the eastern U.S., and the January 1988 hike boosted it to $650. Meanwhile, transaction prices continued significantly below list, in the range of US$570 to $610/ton through most of 1988. By the year's final quarter, transaction rates began to erode significantly, and this continued into the next year. By June 1989, market prices had plunged to a new trough of US$575/ton in the eastern U.S. and $560/ton in the western U.S.

During the 1980s, Canadian newsprint exporters were well served by the weak Canadian dollar, which shielded them from the worst of the price weakness at the beginning of the decade, making the subsequent price recovery all the more profitable. While newsprint prices in the U.S. market rose about 59% in U.S.-dollar terms between 1977 and 1986, the increase was 111% in Canadian dollars. Conversely, as the Canadian dollar climbed in 1987-89, Canadian producers saw their profits fall. In first-quarter 1989, earnings fell 14% compared with a year earlier, primarily due to the 5¢ drop in the U.S. dollar during that time.

DOMESTIC PRICING

Historically, Canadian prices have not risen as rapidly for products intended for domestic use as they have for major export commodities. That was not true of the 1976-85 period, however. Among export grades, only newsprint rose faster than domestic prices for printing/writing papers and containerboard. Domestic containerboard prices rose an average of 7.9%/year during the 1976-85 period, compared with 9.3% for exported newsprint and only 5.3% for bleached kraft pulp exports. Fine paper prices in the domestic market rose an average of 5.7% annually during the same period.

This trend did not continue in the second half of the 1980s. With the steep rise in prices for woodpulp—a major export commodity—the momentum of domestic prices lost considerable ground. In 1987, the latest year for which price-index statistics are available, domestic prices for fine papers rose 7.0%, containerboard prices climbed 8.5%, and pulp export prices jumped more than 24%. However, the rise in offshore newsprint prices was just 5.0% in 1987.

Canadian prices generally track U.S. pricing activity, but Canadian mills enjoy a comfortable dominance of their domestic markets in the whole range of pulp, paper, and board products; and that helps them to maintain adequate pricing. For example, in 1987 the major imported pulp and paper commodity was printing/writing papers, amounting to 334,000 metric tons (about 30% of apparent domestic consumption). The second-biggest category was imported wrapping papers at 44,000 tons.

When U.S. prices for printing/writing papers were near their cyclical peak in early 1981, and when coated No. 3 printing paper (60-lb rolls) went for US$897/short ton in the U.S., Canadian buyers by one estimate paid the equivalent of US$1,070. Also at that time, Canadian consumers paid an estimated US$30/short ton more for their 50-lb multiwall kraft sack paper than the $405 price in the U.S.

The price index for domestic writing and reproduction papers in Canada rose 83% between 1976 and 1987. Over the same period, the offset uncoated book paper price index in the U.S. rose 53%. The disparity was much higher in containerboard, where Canadian prices climbed 110% during the 1976-87 period, compared with 58% for kraft linerboard in the U.S. Canadian mills have traditionally found it easier to pass along price increases to converters. Now that the Canadian currency has strengthened relative to the U.S. dollar, it could weaken the position of some Canadian mills in their domestic markets. U.S. producers will find it easier to compete in Canada because of currencies and a new trade agreement between the two countries that will eliminate tariffs by 1993.

Trade barriers were also one reason for the price disparity. Domestic producers were protected in the past by relatively high tariffs of approximately 15% on a range of grades. However, a staged reduction from 1980 to 1987 reduced those barriers by more than half in most cases.

In 1987, the U.S. and Canada negotiated a trade agreement to remove the remaining barriers and to open both markets to free competition. This was expected to benefit the U.S. paper industry by adding an estimated US$85.9 million in export dollar volume by 1999, according to the New York State Dept. of Economic Development. Canadian pulp and paper mills, however, were not expected to reap much of an advantage. Rather, Canada's major export growth potential was in offshore trade, particularly with Pacific Rim countries.

PRICE INDEXES FOR SELECTED COMMODITIES

(1981=100)

Year	Fine paper—writing and reproduction (domestic)	Containerboard (domestic)	Bleached sulfite pulp (export)	Bleached sulfate pulp (export)	Unbleached sulfate pulp (export)	Newsprint (export)
1987	127.5	148.8	119.2	122.4	122.5	129.2
1986	119.2	137.2	95.6	98.2	98.1	123.0
1985	114.9	135.3	83.7	87.3	86.9	119.7
1984	112.6	128.9	97.1	102.3	102.2	109.6
1983	106.4	119.3	79.7	80.9	80.6	98.7
1982	106.4	112.1	92.4	93.6	93.5	104.7
1981	100.0	100.0	100.0	100.0	100.0	100.0
1980*	219.0	238.5	342.1	341.0	379.0	300.2
1979*	197.7	200.2	279.4	278.9	303.0	268.0
1978*	173.6	171.7	210.2	213.1	216.0	236.4
1977*	165.0	166.7	220.8	233.1	221.0	210.4
1976*	161.6	162.5	218.8	230.6	226.9	177.6
Average annual change						
1981-87	4.2%	6.9%	4.3%	4.8%	4.9%	4.4%
1976-80	6.3	9.4	8.8	8.4	11.3	11.9

* Base year for 1976-80 data is 1971.

Source: *Statistics Canada.*

Canada:

PROFITABILITY

Virtually the entire North American pulp and paper industry enjoyed a second consecutive year of record profits in 1988. On both sides of the border, and for many of the same reasons, producers watched earnings soar to new heights, although growth was not as significant as it was in 1987.

For Canadian companies, as in the U.S., a weak currency that encouraged exports once again provided a healthy boost for sales. However, trade between the two countries was not as profitable for the Canadians due to the rise in the value of their currency compared with the U.S. dollar.

Continued strong demand in most grades, nevertheless, increased the volume of shipments and allowed producers to raise prices. Cost-reduction programs instituted as survival measures in recent years also contributed to dramatic earnings increases at several companies.

Market pulp provided much of the impetus behind 1988 profits, sending them up about 25%. Newsprint, the other major Canadian export commodity, put a damper on industry returns as markets weakened steadily through the second half of the year.

Overall 1988 earnings rose just 6.3%. Producers were helped by the strength of European currencies in relation to the Canadian dollar; however, the U.S. dollar's weakening in relation to Canadian currency was a negative factor. As markets for newsprint lagged onshore and as net profits in sales to the U.S. shrunk, Canadians were attracted to firmer overseas markets with more favorable currency exchange rates.

Prospects for 1989 looked even less promising as the year progressed. Contributing factors were the additional worldwide capacity in both market pulp and newsprint, continued sluggishness in the U.S. economy, and a strong Canadian dollar.

Abitibi-Price Inc. racked up a 49.7% increase in earnings on sales of C$3.3 billion in 1988. Despite a weakening newsprint business, the company managed to keep prices firm enough throughout the year to offset the strengthening Canadian dollar. In addition, the company's Printing Papers and Diversified Groups reported strong gains, with further growth projected in 1989.

Noranda Forest Inc.'s earnings improved 29.6% to C$263 million on sales of $4.7 billion. A decline in the company's wood products sector was more than offset by gains in most other products. The stumpage systems in Quebec and British Columbia, in addition to softening worldwide demand, were largely responsible for squeezing wood-products returns, the company said.

Strong prices for pulp and containerboard products as well as for newsprint boosted MacMillan Bloedel Ltd.'s 1988 earnings to a record C$329 million on sales of $3.3 billion. Part of this growth was attributed to the strong showing of Dutch affiliate KNP, with its access to European fine papers markets.

Canadian Pacific Forest Products Ltd. posted a 51% improvement in earnings to C$323.4 million on sales of $3 billion. This was lower than previously forecast due to the direction taken by the Canadian dollar later in the year. Each US1¢ change in the value of Canadian currency results in a change in net earnings of approximately C$15 million, CPFP indicated.

Consolidated-Bathurst Inc. had an 11.8% increase in earnings to C$239 million on sales of $2.3 billion. U.K. newsprint operations played a big role in the higher results, while earnings from sales of newsprint and groundwood specialties to the U.S. were down because of currency exchange rates and reduced shipments. Added to this were significant nonrecurring costs related to the startup of Con-Bath's new corrugating medium machine at Bathurst, N.B.

Overall earnings for Domtar Inc. dropped 31.1% in 1988 to C$111 million. Operating profit for the pulp and fine papers businesses declined because of a strike at the Lebel-sur-Quévillon, Que., pulp mill, which significantly reduced shipments of market pulp and also adversely affected start-up of the rehabilitated Windsor, Que., mill and operation of Domtar's other fine papers mills. Profits for newsprint and groundwood specialties as well as for packaging products increased because of higher selling prices.

Repap Enterprises Corp. generated earnings of C$92.8 million in 1988, an increase of 48.5% from 1987. A record C$1 billion in sales was up 11.1% from 1987. Both the expansion at Miramichi Pulp & Paper Inc. and a C$80-million modernization at the Skeena Cellulose Inc. pulp complex were expected to be completed in 1989.

OUTLOOK FOR 1989

Predictions of an industry downturn began coming true for many Canadian forest products companies in first-quarter 1989 as profits plummeted 14.1% on an 0.5% drop in sales. Producers attributed the decline to a weak newsprint market and to the rising Canadian dollar, which relative to the U.S. dollar was about 5¢ higher than it was during the same quarter a year earlier. Higher income from fine papers and paperboard operations partially offset these negative factors. Results from wood products were mixed.

In early 1989, the Canadian dollar had a value of about 84¢ to the U.S. dollar, although it occasionally drifted as high as 86¢. This gave Canadians considerably less leverage in pricing, compared with 1987 when their currency averaged 75.5¢ to the U.S. dollar, or even 1986 when it bottomed out at 72¢.

The lumber sector, hard hit in British Columbia by government timber-cutting and reforestation fees, has declined since 1988. On top of this, the U.S. housing market has eased, but Japan's building industry has picked up slightly.

While signs of weakness in newsprint were apparent by late 1988, pulp's cycle began to top out in early 1989. Quarter-by-quarter price increases are not expected to be automatic, as they were during the previous three years. Further investment is also needed to bring many pulp mills into compliance with new government standards covering dioxin emissions.

In first-quarter 1989, Abitibi-Price reported a 40.2% dive in earnings to C$26.3 million, due to downward pressure on newsprint prices, shrinking margins, and inflationary cost increases "greater than Abitibi has experienced in six years," according to Bernd K. Koken, chairman and CEO. Sales volume improved by 1.3% to C$810 million. The Printing Papers Group suffered a setback due to a production problem at one mill, while the Diversified Group's results were flat from a year earlier.

The profits of Noranda Forest dropped 7.9% to C$58 million during the first quarter of 1989. Sales, however, rose 3.4% to C$1.2 billion. Declines in newsprint and lumber margins were largely offset by gains in pulp, printing/writing papers, and paperboard. Chairman Adam H. Zimmerman said Noranda's outlook for the rest of 1989 remained postive.

Strong pulp and containerboard markets and high demand for specialty lumber offshore helped bolster MacMillan Bloedel's earnings, but these factors could not offset the stronger Canadian dollar or the softening newsprint market. MB's profits in the first quarter of 1989 dropped about 20% to C$73.4 million on sales of $807 million. Nevertheless, MB was in a good position to face any downturn because of long-term investments, said Ray Smith, president and CEO.

In first-quarter 1989, Canadian Pacific Forest Products posted a 12.4% decline in earnings to C$65.1 million on sales of $711 million. With more than half of its sales made in U.S. dollars, the company was hit hard by escalation of the Canadian dollar against its U.S. equivalent. A buoyant pulp market helped ease the loss.

Domtar's 29.7% dip in earnings to C$26 million on sales of $595 million was attributed to interest expenses related to financing for its new Windsor, Que., fine paper machine. In late spring 1989, Domtar also curtailed a newsprint mill in eastern Canada due to lack of orders.

The profits of Fletcher Challenge Canada Ltd. dropped 20.5% to C$36.1 million during the first quarter of 1989; sales dropped 5.8%. Ian Donald, president, said weaker newsprint demand and slower wood products markets mean "net profits will be below the record performance we achieved last year."

CANADIAN PULP AND PAPER COMPANY SALES AND EARNINGS FOR 1988

(C$ 000)

Companies	Sales	% change 1988/87	Earnings	% change 1988/87
Abitibi-Price	C$3,304,500	10.6%	C$188,200	49.7%
Canfor	1,084,200	-12.9	101,600	-4.2
Canadian Pacific Forest Products	3,000,000	7.1	323,400	11.8
Cascades	588,792	11.6	32,505	51.0
Consolidated-Bathurst	2,372,000	4.9	239,600	11.8
Domtar	2,700,000	5.1	111,000	-31.1
Donohue	648,300	27.1	68,700	55.4
Fletcher Challenge Canada	1,500,000	7.1	180,200	28.5
MacMillan Bloedel	3,273,500	4.4	329,800	17.5
Noranda Forest	4,700,000	4.4	263,000	29.6
Repap Enterprises	1,030,000	11.1	92,800	48.5
Scott Paper	313,173	8.6	16,245	11.9
Weldwood of Canada	894,500	20.7	62,000	30.3
West Fraser Timber	411,700	7.3	47,200	17.4
Total	25,820,665	10.0	2,056,250	30.3

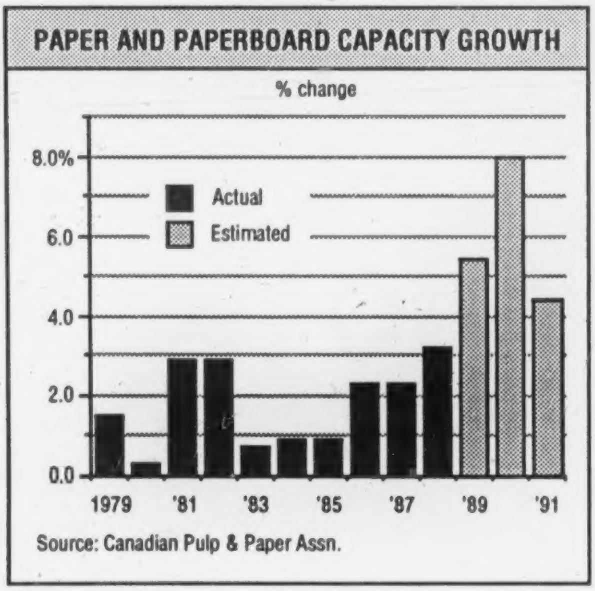
1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years. Dollar amounts are rounded to nearest hundred.

Canada:

CAPACITY EXPANSION

With several years of excellent returns under their belts, Canadian pulp and paper companies have extended their ambitious capacity expansion plans into the early 1990s. According to the 1988-91 Canadian Pulp & Paper Assn. capacity survey, growth will be over three times as strong in the 1989-91 period as in the preceding ten years. Growth will average 5.89%/year for paper and board, compared with 1.77% over the 1979-88 period. Market pulp capacity will grow an average 3.99% annually through 1991, up from 1.32%/year over the past ten years.

Total Canadian paper and paperboard capacity will climb from 17.0 million metric tons in 1988 to 20.3 million tons in 1991, an increase of 19.2%, CPPA reported. Total pulp capacity will climb 13.5% over the same period, from 25.0 million tons in 1988 to 28.4 million tons in 1991. Market pulp capacity, which accounts for about one-third of total pulp capacity, will rise 12.5% from 8.4 million tons in 1988 to 9.5 million tons in 1991.


PAPER AND PAPERBOARD CAPACITY GROWTH

Source: Canadian Pulp & Paper Assn.

Some of the strong growth forecast for the 1989-91 period was originally planned for 1988. In late 1987, producers reported plans to add 652,000 tons of paper and paperboard capacity in 1988, but CPPA's 1989 survey shows that the actual tonnage added in 1988 was 549,000 tons, about 16% less than forecast. However, the forecast for 1989 has been revised upward by 14% from a year ago, and plans for 1990 are much stronger. Companies now plan to add 47% more new capacity next year than they originally planned.

These sharp increases come despite indications that the party may be over for newsprint producers and that the industry in general will be hard-pressed to improve on its record performance of the past two years. Newsprint markets have weakened, and the stronger Canadian dollar has cut into profits from export sales denominated in U.S. dollars. Despite these problems, producers remain committed to expanding capacity now, while cash flow is at record levels.

Growth plans have been above-normal in the Canadian industry since 1986, when companies began to recover in earnest from the hard times of the early 1980s. Most of the growth, however, was in the smaller, nontraditional grades—higher-value printing/writing paper or mechanical market pulp—which require less capital than chemical grades. Canada's bread-and-butter export grades, newsprint and bleached kraft market pulp, experienced little or no growth.

This situation turned around dramatically in 1988, when suddenly every major producer seemed ready to add newsprint capacity. Plans for new machines skyrocketed, and it appears that over the 1989-91 period, newsprint capacity will climb at the highest rate in several decades. Kraft pulp expansion plans also began to pick up in 1988, with a major push from Japanese companies announcing new mills for

CANADIAN INDUSTRY CAPACITY

(000 metric tons)

MARKET PULP

Year	Sulfite paper grades	Sulfate paper grades: Total	Sulfate paper grades: Bleached softwood	Sulfate paper grades: Semi-bleached softwood	Sulfate paper grades: Bleached hardwood	Sulfate paper grades: Unbleached	Total chemical paper grades	Dissolving & special alpha	Mechanical	Total market pulp capacity	% increase from previous year
1991e	340	7,570	5,784	425	1,251	110	7,910	252	1,298	9,460	5.2%
1990e	340	7,252	5,716	392	1,034	110	7,592	252	1,147	8,991	2.0
1989e	341	7,088	5,664	374	935	115	7,429	273	1,110	8,812	4.8
1988	323	7,067	5,665	376	913	113	7,390	277	745	8,412	2.8
1987	331	7,004	5,533	473	873	125	7,335	245	599	8,179	2.4
1986	316	6,835	5,396	501	809	129	7,151	245	589	7,985	6.4
1985	305	6,624	5,233	420	794	177	6,929	266	574	7,769	1.3
1984	279	6,606	5,134	405	869	198	6,885	264	521	7,670	0.1
1983	322	6,571	5,130	453	780	208	6,893	267	500	7,660	0.6
1982	369	6,471	5,128	438	669	236	6,840	305	472	7,617	2.5
1981	397	6,413	5,056	433	634	290	6,810	303	317	7,430	2.7
1980	360	6,330	4,905	550	605	270	6,690	307	240	7,237	1.8

PAPER AND BOARD

Year	Newsprint[1]	Uncoated mechanical	Uncoated woodfree	Kraft papers	Tissue sanitary, special[2]	Containerboard	Boxboard	Total (excluding building, other)	Building, other[3]	Total paper/board capacity	% increase from previous year
1991e	11,565	1,982	1,544	539	682	2,275	974	20,296	760	21,056	4.4%
1990e	11,035	1,839	1,517	523	656	2,253	912	19,420	758	20,178	8.0
1989e	10,350	1,709	1,322	531	592	2,099	798	17,936	748	18,684	5.1
1988	10,085	1,495	1,046	560	561	2,039	767	17,028	706	17,734	3.1
1987	9,920	1,360	931	579	561	1,965	773	16,519	666	17,185	2.3
1986	9,885	1,262	892	579	509	1,901	775	16,158	646	16,804	2.3
1985	9,820	1,040	898	541	502	1,869	798	15,783	649	16,432	0.9
1984	9,820	925	1,126	531	503	1,849	798	15,552	740	16,292	0.9
1983	9,970	800	1,026	554	486	1,794	767	15,397	751	16,148	0.7
1982	9,935	750	1,008	527	492	1,799	758	15,269	767	16,036	2.9
1981	9,490	660	1,019	566	467	1,884	792	14,878	711	15,589	2.9
1980	9,130	660	982	562	437	1,818	807	14,396	750	15,146	0.3

e = Estimate.

1. Figures have not been adjusted for changes in grammage of newsprint, and they are not directly comparable year to year.
2. Includes glassine and greaseproof papers.
3. Includes wet machine board.

Source: Canadian Pulp and Paper Assn.

Note: In its 1989 report on capacity expansion plans, CPPA replaced two old categories of printing/writing papers with four new categories. "Uncoated mechanical" replaces "Groundwood Printing & Specialty" with no change in data. "Uncoated woodfree" replaces "Book, Fine & Misc. Fine," but data are the same only through 1984. CPPA also added two categories of coated paper with data back to 1985:

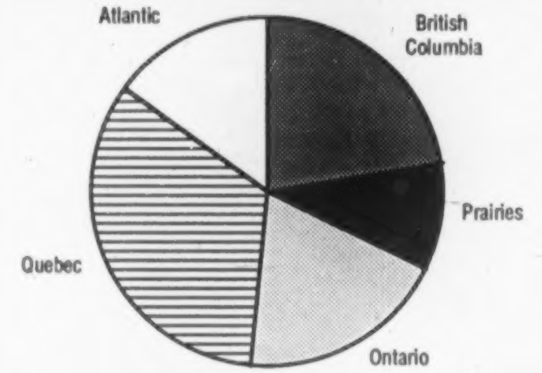
Year	Coated mechanical	Coated woodfree
1991e	555	180
1990e	520	165
1989e	390	145
1988	345	130
1987	330	140
1986	215	140
1985	175	140

western Canada. Some forward integration into white papers will depress growth somewhat in bleached softwood kraft market pulp capacity, but even so, chemical papergrade market pulp capacity will climb at twice the historical rate over the next three years.

Mechanical market pulp capacity will also continue to grow rapidly. These grades will account for 13.7% of total market pulp capacity in 1991, up from 8.9% last year.

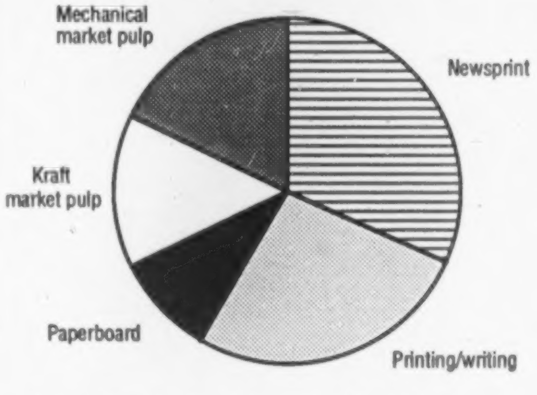
New machines fuel newsprint growth. Newsprint producers plan to add 1.48 million tons of capacity by 1991, raising total tonnage 14.7% to 11.6 million tons. Eight new newsprint machines are due to come online by 1991. Growth will average 4.7%/year, compared with just 0.9% annually over the past ten years.

CAPACITY EXPANSION PLANS BY REGION, 1989-91



Sources: Canadian Pulp & Paper Assn., Pulp & Paper Project Report.

CAPACITY EXPANSION PLANS BY GRADE, 1989-91



Sources: Canadian Pulp & Paper Assn., Pulp & Paper Project Report.

Expansion plans for newsprint in 1989 were heavily revised from what was announced in 1988, and the boom is expected to hit even more strongly in 1990. Producers added just 165,000 tons of newsprint capacity in 1988, 31% less than originally planned, and the growth estimate for 1989 is 28% lower than expected the year before. Companies plan to add 685,000 tons in 1990, about 34% more than expected in 1988.

In 1989, capacity is expected to rise 2.6% with the addition of 265,000 tons. Finlay Forest Industries Inc. integrated its refiner mechanical market pulp mill in Mackenzie, B.C., starting up a new 216,000-tpy newsprint machine at the beginning of 1989. Gold River Newsprint Co. plans to bring online its new 225,000-tpy newsprint mill at Gold River, B.C., in the fall of 1989.

In 1990, capacity will rise 685,000 tons, up 6.6% from 1989, and four new paper machines are scheduled to come online. Atlantic Packaging Products Ltd. plans to install a new 110,000-tpy recycled newsprint machine at Whitby, Ont., by mid-year. Kruger Inc. will start up a new 180,000-tpy machine at Trois Rivières, Que., early in the year, and Alberta Newsprint Co. plans to open its new 220,000-tpy mill at Whitecourt, Alta., in August. The Kruger capacity expansion will be offset to a degree by conversions of older machines to supercalendered (sc) groundwood grades. Consolidated-Bathurst Inc.'s new 183,000-tpy machine at Grand'Mère, Que., is expected to start up at mid-year. This machine will produce specialty grades rather than commodity newsprint.

In 1991, companies will add another 530,000 tpy, or 4.8%, to capacity. Two new machines are slated to come online: a 200,000-tpy unit at Howe Sound Pulp & Paper Co.'s new mill in Port Mellon, B.C., and a new 240,000-tpy unit at Canadian Pacific Forest Products Ltd.'s Thunder Bay, Ont., facility. The new Thunder Bay machine will replace two existing units, for a net increase of 60,000 tpy.

Other paper grades. Capacity for printing/writing papers will jump 41.3% to 4.24 million tons by 1991, according to CPPA. Growth will average 12.3%/year through 1991, compared with 7.5% annual growth over the 1978-88 period. The biggest increases are planned for coated groundwood, which will rise 60.9% to 555,000 tons by 1991, due primarily to the 1989 startup of one machine at Repap Enterprises Inc.'s Newcastle, N.B., mill.

Four new paper machines will raise uncoated free-sheet capacity 47.6% to 1.54 million tons by 1991. In 1988, Weyerhaeuser Canada Ltd. integrated its Prince Albert, Sask., market pulp mill with a new 220,000-tpy machine. In second-quarter 1989, Domtar Inc. brought onstream another new machine at Windsor, Que.; the first new machine came online in 1987. The mill now has capacity for 320,000 tpy. Also in the second quarter, Canadian Pacific Forest Products started up its new 175,000-tpy paper machine at Dryden, Ont.

A new coating facility at Island Paper Mills Co.'s New

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR CANADA

Company	Location	Project	Grade	Capacity (metric tpy)
Started up in 1986				
Domtar	Trenton, Ont.	new machine	corrugating medium	99,000
Repap Enterprises	Newcastle, N.B.	new mill	coated groundwood	200,000
Tembec	Temiscaming, Que.	new mill	bleached CTMP	100,000
Started up in 1987				
CIP	Gatineau, Que.	new machine	newsprint	175,000
Domtar	Windsor, Que.	new machine	uncoated free-sheet	175,000*
Donohue	Clermont, Que.	new machine	newsprint	180,000
Started up in 1988				
Consolidated-Bathurst	Bathurst, N.B.	new machine	corrugating medium	150,000*
Fibreco Export	Taylor, B.C.	new mill	bleached CTMP	180,000
Millar Western	Whitecourt, Alta.	new mill	bleached CTMP	210,000
St. Marys Paper	Sault Ste. Marie, Ont.	new machine	SC groundwood	118,000
Weyerhaeuser Canada	Prince Albert, Sask.	new machine	uncoated free-sheet	220,000
For startup in 1989				
Atlantic Packaging	Whitby, Ont.	new mill	tissue	35,000
Canadian Pacific Forest Products	Dryden, Ont.	new machine	uncoated free-sheet	175,000
Canadian Pacific Forest Products	Gold River, B.C.	new mill	newsprint	225,000
Domtar	Windsor, Que.	new machine	uncoated free-sheet	175,000*
Finlay Forest Industries	Mackenzie, B.C.	new machine	newsprint	216,000
Irving Pulp & Paper	St. John, N.B.	new machine	tissue	60,000
Repap Enterprises	Newcastle, N.B.	new machine	coated paper	260,000
Tembec	Temiscaming, Que.	new machine	bleached paperboard	110,000
Vicell Canada Tissue	Delta, B.C.	new mill	tissue	9,000
For startup in 1990				
Alberta Newsprint	Whitecourt, Alta.	new mill	newsprint	220,000
Canadian Pacific Forest Products	Thunder Bay, Ont.	new machine	newsprint	240,000*
Consolidated-Bathurst	Grand'Mère, Que.	new machine	groundwood specialties	183,000*
Donohue	Matane, Que.	new mill	bleached CTMP	190,000
Kruger	Trois Rivières, Que.	new machine	newsprint	180,000*
Peace River Pulp	Peace River, Alta.	new mill	bleached kraft pulp	340,000
Tembec	Temiscaming, Que.	new machine	bleached paperboard	110,000
For startup in 1991				
Alberta Energy	Slave Lake, Alta.	new mill	bleached CTMP	110,000
Alberta-Pacific Forest	Athabasca, Alta.	new mill	bleached kraft pulp	500,000
Howe Sound Pulp & Paper	Port Mellon, B.C.	new mill	newsprint	200,000
Louisiana-Pacific	Chetwynd, B.C.	new mill	bleached CTMP	155,000
Millar Western (1992)	Meadow Lake, Sask.	new mill	bleached CTMP	240,000
Proposed (no startup date announced)				
Cascades	Port Cartier, Que.	new machine	groundwood paper	210,000
Daishowa Canada	Quebec City, Que.	new machine	newsprint	240,000
Makin Pulp & Paper	Britannia Beach, B.C.	new mill	publication papers	140,000
Normick Perron	Val d'Or, Que.	new mill	newsprint	225,000
Nortek Forest Products	Nipawin, Sask.	new mill	mechanical pulp	110,000
Shin Ho Canada	Thunder Bay, Ont.	new mill	bleached CTMP	120,000
Stake Technology	Rimouski, Que.	new mill	mechanical pulp	100,000
Takema Forest	Fort Nelson, B.C.	new mill	bleached CTMP	190,000

n.a. = Not available.
* Replaces some existing capacity.

Westminster, B.C., mill in 1989 is responsible for much of Canada's projected 38.5% jump in coated free-sheet capacity to 180,000 tons by 1991. Uncoated groundwood capacity is expected to grow by 32.6% to 1.98 million tons during the 1989-91 period, due to a new SC paper machine at St. Marys Paper Inc.'s Sault Ste. Marie, Ont., mill and to conversions from newsprint and kraft paper at other mills, CPPA reported.

Three new machines will raise sanitary papers capacity by 23.3% to 613,000 tons in 1991. Atlantic Packaging Products, Whitby, Ont., and Irving Tissue Ltd., Saint John, N.B., will each add a new machine this year. A third machine will be brought online this fall at Cascades Inc.'s Kingsey Falls, Que., mill.

Containerboard capacity will climb 11.6% to 2.28 million tons by 1991. This is due primarily to the new corrugating medium machine that came onstream at Con-Bath's Bathurst, N.B., mill in late 1988 and to an increase in kraft linerboard capacity at Eurocan Pulp & Paper Co.'s Kitimat, B.C., mill in 1989.

A healthy 27.0% jump in capacity is expected in the boxboard sector. Much of the growth in recycled grades comes from Cascades' expansion at Jonquière, Que. Tembec Inc.'s new machine slated to start up in late 1989 at Temiscaming, Que., will fuel a 241.4%, 140,000-ton jump in solid bleached paperboard capacity.

CTMP leads pulp growth. Mechanical pulp capacity growth will represent two-thirds of the increase in total Canadian pulping capacity during the 1988-91 period, according to the CPPA survey. Fueling the increase are four new market chemi-thermomechanical pulp (CTMP) lines that came onstream in 1988, another line slated to start up in 1990, and conversions to thermomechanical pulp and CTMP from other pulp grades, primarily by newsprint mills in Quebec.

Most of these increases are occurring in three provinces. In British Columbia, 870,000 tons will be added; in Quebec, 795,000 tons; and in Alberta, 370,000 tons.

Sulfate pulp capacity is expected to climb 9.6% to 12.6 million tons by 1991. Bleached hardwood capacity will increase 36.1% due to aforementioned fine paper expansions in Ontario and Saskatchewan; increased production at James Maclaren Industries Inc.'s Thurso, Que., mill; and startup of Peace River Pulp Co.'s Peace River, Alta., market pulp mill. Bleached softwood sulfate capacity will increase 7.1% to 7.94 million tons in 1991, mostly at market pulp facilities.

Growth in market pulp capacity also will be most significant in mechanical grades. Mechanical market pulp capacity is expected to climb 74.2% to 1.298 million tons by 1991. Most of this tremendous 553,000-ton expansion is in the form of CTMP. In 1988, Fibreco Export Inc. and Quesnel River Pulp Co. brought new CTMP plants online in British Columbia, and Millar Western Pulp Ltd. started up a new CTMP mill in Whitecourt, Alta. Also in 1988, Cascades Inc. restarted the former ITT Rayonier Inc. dissolving pulp mill at Port Cartier, Que., as a market CTMP facility. In 1990, Donohue-Matane Inc. will complete a new 190,000-tpy CTMP mill in Matane, Que., and Tembec will double the size of its Temcell CTMP plant in Temiscaming, Que.

Market bleached hardwood sulfate pulp capacity will increase by 37.0%, or 338,000 tons, to 1.25 million tons in 1991. This gain is due to expansion of Maclaren's Thurso, Que., mill and to startup of the new Peace River, Alta., mill. Bleached and semibleached softwood sulfate market pulp is expected to rise 2.8%, or 168,000 tons, to 5.78 million tons in 1991. This brings the projected growth in chemical paper-grade pulp capacity to 7.91 million tons in 1991, representing a three-year growth rate of 7.0%.

British Columbia is the most important site for softwood kraft expansions. Major programs are under way at Weldwood of Canada Ltd., Hinton, Alta.; Cariboo Pulp & Paper Co., Quesnel, B.C.; Fletcher Challenge Canada Ltd., Crofton, B.C.; and Howe Sound, Port Mellon, B.C.

Canada:

CAPITAL SPENDING

Despite mixed signals from the economy, Canadian pulp and papermakers plan another huge increase in capital spending in 1989. According to a *Statistics Canada* survey completed in February, the Canadian pulp and paper industry plans to spend a record C$5.28 billion on capital projects in 1989, a whopping 45.0% increase over 1988 spending of $3.64 million.

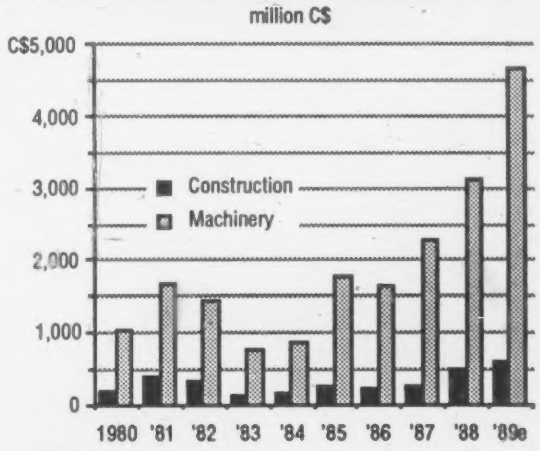
Spending for machinery and equipment will rise to C$4.67 billion in 1989, up 49.4% from 1988 outlays of $3.12 billion. Construction expenditures will amount to C$612 million, up 18.1% from the previous year. Spending for construction rose 102.7% in 1988. The ratio of spending for machinery vs spending for construction is almost 9 to 1—at the high end of the historical range. Machinery and equipment costs have averaged 80% of total capital spending within the Canadian industry over the past 30 years, ranging from a low of 70% in 1969 to a high of 90% in 1979 and 1987.

The increase planned for 1989 marks the third straight year of double-digit percentage gains. The last period of such strong growth was ten years ago, when capital expenditures soared over 60% in both 1980 and 1981. Recession caused capital outlays to turn downward 15% in 1982 and then to plummet by almost half in 1983. Following a year of 12% growth in 1984, capital spending doubled in 1985 to C$2.04 billion. After dropping to C$1.89 billion the next year, capital spending began its present upward march, rising 34.5% in 1987 and 43.3% in 1988.

While efforts during most of the past decade were focused on cost containment and productivity improvement, today's spending plans are driven mainly by capacity expansion, particularly in newsprint, market pulp, and fine papers. Newsprint producers in 1989 are on the leading edge of a huge buildup in capacity that will last into 1991. Chemical market pulp producers are gearing up for what appears to be a similar glut of new capacity that will start coming online in 1990. Much of this pulp mill spending will be funded by overseas interests, particularly the Japanese, who are finding North America a cheap place to invest at current exchange rates. More so than in the U.S., capital spending in Canada is getting a boost from overseas investment. Of ten major expansion programs announced in 1988, five of the largest involve major investments by overseas papermakers.

Entrepreneurial investment is also a major factor in Canadian spending plans. Led by Repap Enterprises Inc., which plans to spend over C$500 million during the next few years, companies such as Cascades Inc. and St. Marys Paper Inc. that have rescued and rejuvenated old mills are responsible for a share of spending out of proportion to

CONSTRUCTION VS MACHINERY COSTS IN CANADIAN CAPITAL SPENDING



e = Estimate.

Source: Statistics Canada.

their size. Another group of entrepreneurs has come in from outside the industry and built new capacity, especially in the West. Fibreco Export Inc. in British Columbia and Millar Western Pulp Ltd. in Alberta exemplify this group. Both brought online new chemi-thermomechanical market pulp mills in 1988, and both are undertaking new investments to expand capacity.

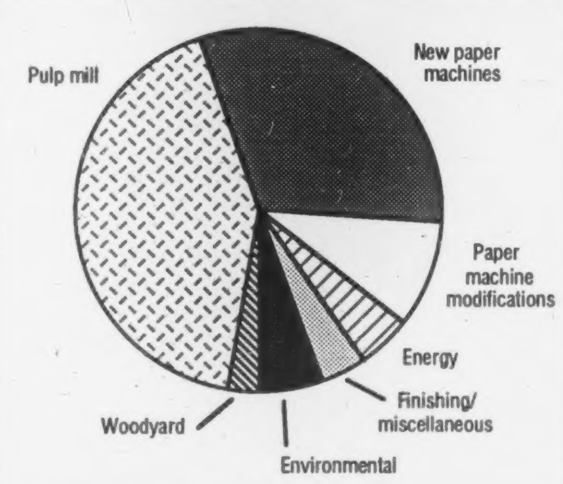
Companies have been cautious about their spending forecasts during the past several years due to uncertainty about the economy. At least since the U.S. stock market crash of late 1987, economists have been regularly forecasting imminent recession, and just as regularly they have been pushing their forecasts back as business conditions stayed strong. In this environment, companies tend to start conservatively, adding spending projects as long as business remains upbeat.

Even if business conditions turn downward in late 1989, companies expect the momentum from record prices for most grades and from strong volumes to carry them through their current spending programs. Companies have enjoyed strong cash flows during 1987-88, and most have reduced debt substantially from the high levels of the early 1980s. Thus, they are in good shape to undertake necessary projects, even though markets may be peaking.

GEOGRAPHIC BREAKDOWN

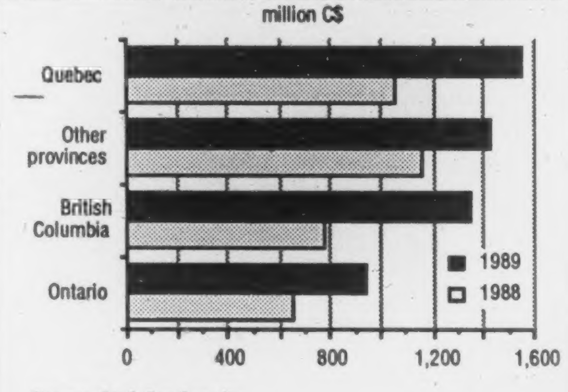
During the past decade, the pattern of provincial expenditures has shifted in focus from western Canada to eastern Canada, and then back again. Until 1982, British Columbia and Alberta led the field in total dollar amounts, capacity expansion, and greenfield mill plans. After 1982, spending programs in Ontario and Quebec eclipsed the western provinces. Weak markets and high production costs dealt a

ESTIMATED CAPITAL SPENDING BY PROCESS AREA, 1987-89



Source: Pulp & Paper Project Report.

CANADIAN SPENDING BY PROVINCE



Source: Statistics Canada.

TOP SPENDERS IN CANADIAN INDUSTRY*

(C$ 000)

Company	1988-90
Abitibi-Price	207,000
Alberta Newsprint	360,000
Bowater	128,000
Canadian Pacific Forest Products	1,069,710
Cascades	123,540
Consolidated-Bathurst	439,600
Crestbrook Forest*	106,435
Daishowa Paper	500,000
Domtar	480,170
Donohue	292,931
Eddy Forest Products	260,760
Eurocan Pulp & Paper	126,000
Fibreco Export	170,000
Finlay Forest Industries	198,000
Fletcher Challenge Canada	359,600
Howe Sound Pulp & Paper*	615,000
Kruger	519,500
Louisiana-Pacific*	200,000
James Maclaren Industries	195,500
MacMillan Bloedel	271,600
Millar Western Pulp	185,000
Quebec & Ontario Paper*	476,000
Reed	146,000
Repap Enterprises	514,000
St. Marys Paper	145,000
Tembec	331,056
Weldwood of Canada	285,000
Weyerhaeuser Canada	262,000

* Includes programs for completion beyond 3-year period indicated.
Note: All totals include production and environmental programs.

heavy blow to British Columbian companies during the recession, while in Quebec and Ontario, federal aid designed to modernize the industry helped some eastern companies when the economy forced internal cutbacks. Recently, however, emphasis on capacity expansion has begun to shift the advantage back to resource-rich western Canada.

British Columbia shows the largest gains in percentage terms among the provinces. Capital spending in 1989 is forecast there at C$1.35 billion, up 75.0% from 1988 when companies spent $772 million. Quebec will most benefit from the big increase in capital spending projected for 1989. Spending in the province is expected to total C$1.56 billion, up 48.1% from outlays of $1.05 billion in 1988.

Companies report plans to spend C$947 million on capital projects in Ontario in 1989, up 43.5% from 1988 when spending totaled $660 million. Percentage gains are not as high in the other provinces (for which individual statistics are unavailable) because of the steep run-up in spending during 1987-88. Spending for capital projects in these "other" provinces is expected to total C$1.43 billion in 1989, up 22.9% from the year before. That compares with increases of 100.9% in 1988 and 77.1% in 1987.

HISTORICAL PATTERN

The past ten years have been a roller coaster ride for capital spending in Canada. Canadian pulp and paper companies boosted capital expenditures dramatically during the late 1970s, when government assistance programs spurred outlays as the industry was gearing up for a heavy round of expansion. Total yearly outlays rose from C$607 million in 1978 to a peak of $2.05 billion in 1981, an increase of 238%. However, that situation reversed itself quickly in the back-to-back recessions of the early 1980s, when pulp and paper companies slashed expenditures on nonessential items. Spending in 1983 dipped to C$903 million, down 48% from 1982 and down 56% from the 1981 peak.

The economic picture began to brighten during the second half of 1983, although more slowly in Canada than in the U.S., and by late 1984, capital spending plans were back on track at prerecession levels. Spending recovered modestly in 1984 to C$1.01 billion, and it exploded in 1985 back above the $2-billion mark.

The big increase in 1985 spending was somewhat surprising, considering that Canadian companies had not fully recovered from the recession. Low prices and increased offshore competition put the squeeze on profit margins during this period, and the industry was also still saddled with debt from the big spending increases of 1980 and 1981. A *Pulp & Paper* magazine survey in late 1985 found a 10% decrease in reported spending plans as many companies continued to defer spending programs. Nevertheless, capital outlays soared to C$2.04 billion for the year, a 100% increase over the 1984 level.

The profit picture improved considerably in 1986, but capital spending slipped from the near-record 1985 pace to C$1.89 billion, down 7% from the previous year. *Statistics Canada* figures show that producers spent about 13% less in 1986 than they originally planned. Spending climbed to a record C$2.54 billion in 1987 on the strength of record earnings and accelerating expansion plans. The stock market crash of October 1987 added a temporary note of uncertainty to the outlook, but companies quickly resumed an aggressive posture, pushing spending up to C$3.64 billion in 1988.

SPENDING BY CATEGORY

In *Pulp & Paper*'s fall 1988 survey of spending, Canadian companies reported plans to raise outlays by 49% to C$9.92 billion for the 1988-90 period. Production-related spending of C$9.40 billion is up 46% from the 1987 survey. Environmental spending plans for 1988-90 total C$240 million, an increase of 118%. Environmental spending should continue to climb over the next few years as mills clean up dioxin discharges. The dioxin fight will be a costly one, estimated by PAPRICAN at almost C$500 million—$10 million for each of Canada's 47 mills.

Air-quality projects registered the highest growth in the survey of environmental spending. Outlays in 1989 are pegged at C$240 million, up 132% from the previous year. Water-quality programs total C$256 million, up 122% from 1988, while spending for solid waste disposal climbs to $27 million, an increase of 30%.

The most important spending categories are pulping projects and new paper machines. Spending for pulping projects is up 70% in 1989, on top of a 53% increase in 1988. Pulping improvements account for 45% of total production-related spending, up from just 24% in 1988. Outlays for new paper machines are up 43% in 1989, after a 107% rise in 1988. Spending will be relatively flat for paper machine rebuilds, as most capacity expansion programs are focused on new machines. Spending in this area totals C$930 million for 1988-90, up just 4% from the 1987 survey.

In percentage terms, energy spending is up the most in 1989, rising 88% from the 1988 level. Mills now report plans to spend C$506 million over the 1988-90 period on energy-related projects, an 88% increase over last year. Most of that big increase can be attributed to the explosion in greenfield pulp and paper capacity.

CAPITAL SPENDING PLANS OF MAJOR CANADIAN PAPER COMPANIES

(C$ million)

	1989e	1988	% change
Abitibi-Price	300	204	47.1%
Noranda Forest	1,000	560	78.6
Quebec & Ontario	126	92	37.0
Stora Forest	31	19	63.2
Tembec	300	61	391.8
Total	1,757	936	87.7

Source: *Pulp & Paper Project Report.*

PAPER AND ALLIED INDUSTRIES' CAPITAL AND REPAIR EXPENDITURES

million C$

	Capital spending			Repair expenditures		
Year	Construction	Machinery/ equipment	Total	Construction	Machinery/ equipment	Total
1989e	C$611.6	C$4,668.7	C$5,280.3	C$120.7	C$1,638.8	C$1,759.5
1988	517.9	3,124.9	3,642.8	118.4	1,563.1	1,681.5
1987	255.5	2,286.5	2,542.0	92.2	1,514.7	1,606.9
1986	232.8	1,656.8	1,889.6	89.6	1,088.1	1,177.7
1985	263.5	1,772.1	2,035.6	83.1	1,051.7	1,134.8
1984	154.2	860.1	1,014.3	81.3	850.1	931.4
1983	140.9	762.2	903.1	66.5	751.5	818.0
1982	323.2	1,420.0	1,743.2	70.0	783.5	853.5
1981	375.6	1,676.0	2,051.6	71.5	761.6	833.1
1980	192.3	1,040.7	1,233.0	68.4	682.4	750.8
1979	77.8	685.3	763.1	59.2	604.0	663.2
1978	94.3	513.0	607.3	48.2	487.5	535.7
1977	168.9	521.3	690.2	35.1	445.7	480.8
1976	114.7	490.1	604.8	36.5	417.1	453.6
1975	87.0	399.9	486.9	24.1	315.0	339.1
1974	102.9	365.8	468.7	28.7	348.0	376.7
1973	77.1	264.8	341.9	17.5	264.3	281.8
1972	100.4	267.8	368.2	13.9	196.8	210.7
1971	128.3	377.9	506.2	11.6	207.0	218.6
1970	122.3	366.0	488.3	12.5	189.8	202.3
1969	97.1	228.6	325.7	11.5	177.0	188.5
1968	58.2	181.9	240.1	10.7	157.0	167.7
1967	99.0	319.5	418.5	10.6	158.1	168.7
1966	127.2	379.2	506.4	12.3	139.1	151.4
1965	102.2	281.6	383.8	12.9	118.5	131.4
1964	64.7	229.0	293.7	9.2	112.7	121.9
1963	36.4	145.2	181.6	11.0	96.8	107.8
1962	34.5	113.3	147.8	10.5	96.2	106.7
1961	33.1	105.3	138.4	7.7	92.6	100.3

Source: *Statistics Canada.*

Canada:

MERGERS AND ACQUISITIONS

Ever since the late 1970s, merger and acquisition activity in the Canadian pulp and paper industry has been largely cyclical, responding to the ups and downs of the general economic climate. For example, the years 1978-81 were hectic, with the most significant events during that period being the takeovers of Canada's two largest pulp and paper companies—MacMillan Bloedel Ltd. and Abitibi-Price Inc.—by outside interests.

The pendulum swung in the opposite direction as the recession of 1982 halted takeover activity. During the following two years, only three major ownership changes took place: Crown Zellerbach Corp. sold its Canadian operations to Fletcher Challenge Ltd. of New Zealand; Western Forest Products Ltd. sold its two British Columbian pulp mills to a limited partnership group; and Bowater Corp. of the U.K. spun off its North American assets into Bowater Inc.

Consolidating ownership. The pattern of smaller, more select purchases continued in 1985. Still not fully recovered from the overexpansion of the early 1980s, companies were cautious in their spending plans. Canfor Corp., CIP Inc., ahd Noranda Inc. all consolidated their holdings in 1985 by purchasing the remaining assets of companies in which they already held majority stakes. Meanwhile, Rauma-Repola Oy of Finland, a major supercalendered paper producer, bought 25% of St. Marys Paper Co. of Ontario as both an entrée into the North American marketplace and an avenue for possible future cooperative ventures.

The one major exception to the small-scale deals that took place during 1985 was Gulf Canada Ltd.'s purchase of 90% of the stock of Abitibi-Price from real estate developers Olympia & York Developments Ltd. Gulf's acquisition of Abitibi was accomplished in four installments over a period of four months. Its final share of Abitibi was diluted, however, when Abitibi issued additional common shares and common share purchase warrants in April 1986, bringing Gulf's ownership down to approximately 83.4%. Gulf further reduced its Abitibi interest in 1987 by spinning off its shares in a major reorganization of its total holdings, which increased the public float of Abitibi shares to 27%. Olympia & York, in the meantime, gradually boosted its ownership to a level exceeding 84% by late 1989.

A bit of controversy accompanied the 1985 purchase of ITT Rayonier Inc.'s idle Port Cartier, Que., dissolving pulp mill by Cascades Inc. and Rexfor, the provincial forestry corporation. Plans to approve government funding of a mill conversion to chemi-thermomechanical pulp production were criticized by the Canadian Pulp and Paper Assn., which claimed that the government's assistance in the Port Cartier project was unfair to other Canadian producers.

The other major pulp mill purchase of 1985 proceeded uneventfully, as Repap Enterprises Inc. acquired Boise Cascade Canada Ltd.'s Newcastle, N.B., kraft pulp mill. The major significance of this deal was Repap's intention to construct a lightweight coated groundwood mill at the Newcastle site, using part of the pulp mill's output to provide some of the furnish needed for the new operation.

More mill sales. The level of acquisition activity in 1986 did not increase from that of the previous year, although the deals themselves were increasingly newsworthy. As the year progressed, the level of activity accelerated, with many deals reaching conclusions in 1987. In a joint venture of international scope announced in June 1986, a partnership was formed by Consolidated-Bathurst Inc., Power Corp. of Canada, and China International Trust & Investment Corp. (CITIC—the investment agency of People's Rep. China) to purchase Westar Timber Ltd.'s Castlegar, B.C., kraft market pulp mill. The deal was the first major investment made by CITIC, giving it a 50% share in the mill. The two Canadian companies each acquired 25% shares.

Weyerhaeuser Canada Ltd., in a deal reminiscent of Repap's, bought Prince Albert Pulp Co. Ltd. and announced plans to build a new paper mill at the Saskatchewan site to produce uncoated free-sheet papers. Repap, meanwhile, further expanded its presence in the industry by purchasing Westar Timber's Prince Rupert, B.C., kraft market pulp mill. With the sales to Repap and the Con-Bath/PCC/CITIC partnership, Westar removed itself from the ranks of Canadian pulp producers.

Major sales in early 1987. The biggest deals during the first half of 1987, in terms of both money and publicity, were the sales of Donohue Inc. and British Columbia Forest Products.

In the fall of 1986, the Quebec government offered for sale its shares of both Donohue and Domtar Inc., drawing interest from a large variety of sources. A deal was finally struck in February 1987, when an offer for the Donohue shares, tendered by Quebecor Inc. and Maxwell Communications Inc. (formerly British Printing & Communication Corp.), was deemed acceptable by the Quebec government. The C$320-million deal for 55.25% of Donohue was completed in July. The Domtar shares, which appreciated greatly in value following the original offer to sell, failed to find a buyer and remained under Quebec's control.

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS

Acquiring company	Assets purchased	Estimated value (C$ million)	Year
Stone Container Corp.	Consolidated-Bathurst Inc.	C$2,600	1989
Doman Industries Ltd.	Increased stake in Western Forest Products Ltd. to 56%	137	1989
Repap Enterprises Inc.	Manfor Ltd.	132	1989
Scott Paper Ltd.	E.B. Eddy Forest Products Ltd.'s White Swan Tissue Div.	110	1989
West Fraser Timber Ltd.	50% stake in Alberta Newsprint Co. Ltd.	n.a.	1989
Maclaren Industries Inc.	41% stake in Normick Perron Inc.	120	1989
Olympia & York	Raised stake in Abitibi to about 84% as of Nov. 1, 1989	n.a.	1989
Canadian Pacific Ltd.	Merged Great Lakes Forest Products Ltd. with CIP Inc. to form Canadian Pacific Forest Products Ltd.	1,260	1988
Daishowa Paper Manufacturing Co.	Peace River, Alta., greenfield mill	500	1988
Daishowa Paper Manufacturing Co.	Reed International plc's North American Paper Group	650+	1988
Fletcher Challenge Ltd.	Raised stake in BCFP to 67.4% and in Crown Forest to 100%; combined both under Fletcher Challenge Canada Ltd.	573	1988
Kinburn Industrial Corp.	Increased share in Paperboard Industries to 98% from 51.8%	72	1988
Olympia & York	Raised stake in Abitibi to about 74.8% as of Jan. 11, 1988	n.a.	1988
Jefferson Smurfit Corp.	50% stake in Temboard & Co. Ltd.	30	1988
Abitibi-Price Inc.	Gulf Canada Ltd. spins off its 83% share of Abitibi, increasing the public float of Abitibi shares to 27%	n.a.	1987
Cascades Inc.	Acquires 32% of "Class B" voting stock and 28.7% of "Class A" nonvoting stock of Rolland Inc. in takeover attempt	4.5	1987
Domtar Inc.	Genstar Corp.'s gypsum wallboard operations	241 (US)	1987
Fletcher Challenge Ltd.	Acquires 47% of British Columbia Forest Products Ltd.	505	1987
Oji/Canfor	Howe Sound Pulp Div.	307.5	1987
Paperboard Industries Corp.	Acquires more than 95% of common shares and more than 92% of nonvoting shares of Belkin Inc.	219.5	1987
Quebecor Inc. and British Printing & Communication Corp.	Purchased 56% share of Donohue Inc. held by Quebec government	320	1987
St. Raymond Paper Inc.	Mill president purchases 60,000-tpy groundwood mill (Chute Panet) from Imperial Trust of Montreal	n.a.	1987
Timber Investments Ltd.	Acquires over 99% of outstanding shares of Balco Industries Ltd.	27	1987
Weldwood of Canada	St. Regis Paper Co. (Canada) from Champion	264	1987
Cascades Inc.	60-metric-tpd roofing felt mill at Joliette, Que., from Canadian Gypsum Co. Ltd.; paper machines at Nitec Paper Corp.'s Niagara Falls, N.Y., mill	n.a., 1.75	1986
Consolidated-Bathurst, Power Corp. of Canada, China International Trust & Investment Corp.	Westar Timber Ltd.'s Castlegar, B.C., pulp mill	95	1986
Gordon Investment Corp. and Merrill Lynch Canada Inc.	26.3% stake in BCFP held by Brunswick Pulp & Paper Co. and 15.2% stake in BCFP held by Mead Corp.	n.a.	1986
Paperboard Industries Corp.	Big M Paperboard's Palmyra, Mich., recycled board mill	1.145	1986
Repap Enterprises Inc.	Westar Timber Ltd.'s Prince Rupert, B.C., kraft market pulp mill	110	1986
Waferboard Corp.	Abitibi-Price Inc.'s Smooth Rock Falls, Ont., bleached kraft market pulp mill	45	1986
Weyerhaeuser Canada Ltd.	Prince Albert Pulp Co. Ltd.	248	1986

continued

Also in February 1987, Fletcher Challenge Ltd. of New Zealand made an offer for a 42% interest in BCFP, acquired the previous year by Gordon Investment Corp. and Merrill Lynch Canada Ltd. Fletcher Challenge eventually acquired a 47% stake in the initial offering, and in January 1988 it increased its holdings to 67.4% while simultaneously completing its buyout of Crown Forest Industries. Together, the two acquisitions gave Fletcher Challenge a substantial interest in the Canadian industry, with assets estimated at over $2 billion.

The following year, Fletcher Challenge merged the management groups of Crown Forest and BCFP under a new company called Fletcher Challenge Canada Ltd. This was a novel way of consolidating assets. Although FC owned 100% of Crown Forest, it held only a 69% stake in BCFP and had no intention of raising its stake in the near-term. The merger allowed FC to control both operations, take advantage of synergies and cost savings, and spend its acquisition dollars elsewhere.

Paperboard Industries Corp. also grew through acquisition in 1987. It bought a controlling interest in Belkin Inc. of Vancouver, B.C., in a deal that made it Canada's largest recycled paperboard and packaging company. In February 1988, the company was taken private when Kinburn Industrial Corp. raised its stake to 98% from 51.8%.

In mid-1987, Bowater Inc. was prevented from acquiring control of Canadian forms manufacturer R.L. Crain Inc. A Supreme Court ruling in Ontario upheld the Crain family's multiple voting rights, effectively thwarting the Bowater move.

Cascades Inc. was also blocked in its attempt to wrest control of closely held Rolland Inc. from Rolland family in-

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS (continued)

Acquiring company	Assets purchased	Estimated value (C$ million)	Year
Canfor Corp.	25% share of International Pulp Co. Ltd. held by Feldmühle AG	n.a.	1985
Cascades/Rexfor	ITT Rayonier's mothballed Port Cartier, Que., dissolving pulp mill; government financing approved in early 1986	C$17	1985 1985
CIP Inc.	50% of Tahsis Co. Ltd. not already owned	n.a.	1985
Gulf Canada Ltd.	90% of Abitibi-Price Inc. from Olympia & York in four installments; shares reduced to approximately 83.4% after Abitibi stock offering in April 1986	1,200	1985
Noranda Inc.	32% of Fraser Inc. not already owned	60	1985
Rauma-Repola Oy	25% of St. Marys Paper Co.	n.a.	1985
Repap Enterprises Inc.	Boise Cascade Canada Ltd.'s Newcastle, N.B., kraft market pulp mill	90 (US)	1985
St. Marys Paper Inc.	Sault Ste. Marie, Ont., mill of Abitibi-Price	n.a.	1984
Cascades Inc.	Jonquière, Que., mill of Abitibi	n.a.	1984
Bowater Inc.	Bowater Canadian Ltd., spun off from Bowater Corp.	57	1984
Kruger Inc.	Bowater Inc.'s Corner Brook, Nfld., mill	n.a.	1984
Cascades Inc.	Manville Corp. of U.S.'s 50% share of Papier Kingsey-Falls mill; balance already held by Cascades	1.2	1984
Fraser Inc.	50% of Island Paper Mills at New Westminster, B.C.	25	1983
Fletcher Challenge Ltd.	96% of Crown Zellerbach Canada (since renamed Crown Forest Industries) mill at Campbell River, B.C.	242 (US)	1983
Western Pulp Limited Partnership	Western Forest Products' Port Alice and Squamish, B.C., mills	150	1983
James River Corp. (80%) and Buchanan Forest Products (20%)	Marathon, Ont., mill of American Can	10.5	1983
Cascades Inc.	East Angus, Que., mill of Domtar	n.a.	1983
Employees and outside investors	Bowater's Perkins Papers Ltd. mill at Candiac, Que.	n.a.	1983
Fletcher Challenge Ltd.	84% interest in Crown Zellerbach Canada Ltd.	242	1982
Noranda Mines Ltd.	49% of MacMillan Bloedel Ltd.	n.a.	1981
Brascan Ltd.	Raised stake in Noranda Mines Ltd. to 39% from 22%	1,100	1981
Olympia & York Developments Ltd.	Increased stake in Abitibi-Price Inc. to 88%	530	1981
Canadian Pacific Enterprises Ltd.	Canadian International Paper Co.	1,100	1981
Alberta Energy Co.	Noranda Mines Ltd.'s 28% stake in British Columbia Forest Products Ltd.	215	1981
Belkin Packaging Ltd.	Continental Group's two Canadian boxboard mills and three folding carton plants	60	1981
British Columbia Forest Products Ltd., Doman Industries Ltd., and Whonnock Industries Ltd.	Rayonier Canada, division of ITT Industries of Canada Ltd.	420	1980

n.a. = Not available.

terests. Cascades purchased 32% of Rolland's voting stock and another 29% of nonvoting stock in early 1987. Nevertheless, Cascades was denied a seat on Rolland's board of directors, and the family retained its controlling share in the company.

Foreign investment trend. By late 1987, it was apparent that foreign investment would be the new trend in the Canadian pulp and paper industry. In December 1987, Oji Paper Co. Ltd. of Japan and Canfor Corp. announced they would form a partnership to acquire Canfor's Howe Sound Pulp Div. at Port Mellon, B.C., and its Westcoast Cellufibre Industries sawmill and chipping plant at Vancouver. The new company, Howe Sound Pulp & Paper Co. Ltd., is building a 200,000-metric-tpy newsprint machine that is slated to start up in 1991. Oji will market the output.

In February 1988, Daishowa Paper Manufacturing Co. committed to building a 340,000-tpy bleached kraft market pulp mill near Peace River, Alta. The C$500-million project was expected to be completed in 1990, with much of the output marketed in Japan. The federal government agreed to provide $9.5 million for "infrastructure," and the province contributed $65.2 million for rail and road access.

The Japanese made their biggest Canadian investment in mid-1988. Daishowa announced it would buy Reed International plc's North American Paper Group for C$565 million plus an amount equal to after-tax profits earned from April 2 (the end of the 1988 fiscal year) until the deal closed. Daishowa also agreed to assume an estimated $66 million in debts.

The deal, which concluded later in the year, included Reed's 432,000-tpy newsprint mill at Quebec City, Que., which also makes 35,000 tpy of boxboard and 20,000 tpy of sulfite pulp for market. The Reed acquisition made Daishowa one of the largest foreign investors in Canadian pulp and paper, with a 25% interest in Cariboo Pulp & Paper Co., a 50% share in Quesnel River Pulp Co., and the recent investment in the Peace River mill. Reed was also Daishowa's first venture into the eastern Canadian market.

At about the same time, another overseas investor was looking at a Canadian company. The Kuwait Investment Office (KIO) bought 10.3% of Consolidated-Bathurst for $200 million. Power Corp. of Canada retained its approxi-

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Beaver Wood Fibre	100.00%	Georgia-Pacific, U.S.	Paperboard mill, Thorold, Ont.
Boise Cascade Canada	100.00	Boise Cascade, U.S.	Pulp/paper mills, Fort Francis and Kenora, Ont.
Bowater Mersey	49.00	Washington Post, U.S.	Pulp/newsprint mill, Liverpool, N.S.
	51.00	Bowater, U.S.	
British Columbia Forest Products	67.40	Fletcher Challenge, New Zealand	Two British Columbian mills, one U.S. mill, plus other B.C. and Quebec mill shares
Cariboo Pulp & Paper	50.00	Champion International[1], U.S.	Market pulp mill, Quesnel, B.C.
	50.00	Daishowa Marubeni International, Japan	
Celgar Pulp	50.00	CITIC B.C., People's Rep. China	Market pulp mill, Castlegar, B.C.
	50.00	Stone Container Corp., U.S.	
Crestbrook Forest Industries	32.24	Honshu Paper, Japan	Market pulp mill, Skookumchuck, B.C.
	32.24	Mitsubishi Paper Mills Ltd., Japan	
Crown Forest Industries	100.00	Fletcher Challenge, New Zealand	Pulp/paper mill, Campbell River, B.C.
Daishowa Canada	50.00	Daishowa-Marubeni International, Japan	Proposed mill
Donohue	27.00	Maxwell Communications Inc.[2], U.K.	One pulp/paper mill, plus holdings
Donohue-Charlevoix	44.66	Gannett, U.S.	One machine, Clermont, Que.
Donohue-Malbaie	35.00	New York Times, U.S.	One machine, Clermont, Que.
Eurocan Pulp & Paper	50.00	Enso Forest Products (Enso-Gutzeit Oy), Finland	Pulp/paper/paperboard mill, Kitimat, B.C.
	50.00	West Fraser Timber, U.S.	
Finlay Forest Industries	14.00	Jujo Paper, Japan	Market pulp mill, Mackenzie, B.C.
Gaspesia Pulp & Paper	49.00	New York Times, U.S.	Pulp/newsprint mill, Chandler, Que.
Glassine Canada	100.00	Simkins Industries, U.S.	Paper mill, Quebec City, Que.
Gold River Newsprint	39.50	Nine partners: U.S., U.K, Japan, Singapore	Newsprint mill in Gold River, B.C.
Howe Sound Pulp & Paper[3]	50.00	Oji Paper, Japan	Joint venture
James River-Marathon	80.00	James River, U.S.	Market pulp mill, Marathon, Ont.
Kimberly-Clark of Canada	100.00	Kimberly-Clark, U.S.	Four pulp or paper mills, Ontario
NBIP Forest Products	25.00	Oji Paper Co., Japan	Pulp/newsprint mill, Dalhousie, N.B.
	8.00	Mitsui, Japan	
Northwood Pulp & Timber	50.00	Mead, U.S.	Market pulp mill, Prince George, B.C.

continued

mately 40% majority stake. The other major shareholder was Associated Newspaper Holdings plc of the U.K., with a 15% interest.

Kuwait's interest in Con-Bath paled in comparison with Stone Container Corp.'s C$2.6-billion tender offer in January 1989. Con-Bath's three major shareholders agreed to sell their stakes—amounting to about 65% ownership—to Stone. The offer of $25/share for 100% of the outstanding shares was a 50% premium over the stock's price at that time. The merged operations created the second-largest pulp and paper company in the world. It also gave Stone third-place position among North American newsprint producers and ranked it among the continent's top ten market pulp suppliers. The Con-Bath operations were kept separate, although Stone changed the Canadian division's name to Stone-Consolidated Ltd. The deal also included Con-Bath's overseas operations.

Another U.S. investment in Canada occurred in late 1988, when Tembec Inc. sold to Jefferson Smurfit Corp. a 50% stake in its new 140,000-metric-tpy bleached paperboard mill at Temiscaming, Que. Smurfit paid about C$30 million for an undisclosed number of partnership units in Temboard & Co. Ltd. Partnership, the entity formed to build and finance the new mill. The two partners also planned to start a joint-venture marketing firm to sell the new machine's output. Tembec is responsible for providing technical and marketing expertise. Other investors included the Belkin family of Vancouver, B.C.; Lummus Canada Inc., the general contractor for the new mill; and Rexfor, Tembec's largest shareholder.

Canadian investment up, too. While foreign investors made their mark on the Canadian pulp and paper industry, acquisition activity from within the country was also on the rise. Early in 1988, Weldwood of Canada Ltd. bought St. Regis Paper Co. (Canada) Ltd. from Champion International Corp. in exchange for 16.5 million Weldwood shares, giving Champion an 84.6% ownership in Weldwood. This gave Weldwood control of the 182,000-tpy bleached softwood kraft market pulp mill at Hinton, Alta.

At about the same time, Olympia & York announced it

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES (continued)

Company	% owned	Foreign owner	Assets
Ponderay Newsprint	60.00%	Consortium of five newspaper publishers, U.S.	Proposed newsprint mill, Usk, Wash.
Procter & Gamble Cellulose	100.00	Procter & Gamble, U.S.	Market pulp mill, Grande Prairie, Alta.
Quebec & Ontario Paper	100.00	The Tribune, U.S.	Pulp/newsprint mills, Baie Comeau, Que.; Thorold, Ont.
Quesnel River Pulp	50.00	Daishowa Canada, Japan	Market pulp mill, Quesnel River, B.C.
	50.00	West Fraser Mills (West Fraser Timber)[4], U.S.	
Reed Paper	100.00	Daishowa Paper Manufacturing Co., Japan	Pulp/paper/paperboard mill, Quebec City, Que.
St. Anne Nackawic Pulp & Paper	100.00	Parsons & Whittemore, U.S.	Market pulp mill, Nackawic, N.B.
St. Marys Paper	25.00	Rauma-Repola, Finland	Pulp/paper mill, Sault Ste. Marie, Ont.
Scott Paper Ltd.	50.00	Scott Paper Co., U.S.	Pulp/paper mills in B.C., Quebec
Scott Maritimes	100.00	Scott Paper Co., U.S.	Market pulp mill, Abercrombie Point, N.S.
Sonoco Ltd.	100.00	Sonoco Products Co., U.S.	Paperboard mill, Brampton, Ont; Terrebonne, Que.
F.F. Soucy	100.00	Brant-Allen Industries, U.S.	Pulp/newsprint, Rivière-du-Loup, Que.
F.F. Soucy et Associés	50.00	Brant-Allen Industries, U.S.	Paper mill, Rivière-du-Loup, Que.
	40.00	Dow Jones, U.S.	
Spruce Falls Power & Paper	50.50	Kimberly-Clark, U.S.	Pulp/paper mill, Kapuskasing, Ont.
	49.50	New York Times, U.S.	
Stone-Consolidated	100.00	Stone Container Corp.	Eight mills
Stora Forest Industries	100.00	Stora, Sweden	Pulp/newsprint mill, Port Hawkesbury, N.S.
Temboard & Co. Inc.	50.00	Jefferson Smurfit Corp., U.S.	Bleached board mill, Temiscaming, Que.
Weldwood of Canada[5]	84.60	Champion International, U.S. (see Cariboo Pulp & Paper)	Market pulp mill, Hinton, Alta.
Weyerhaeuser Canada	100.00	Weyerhaeuser Paper, U.S.	Market pulp mills, Kamloops, B.C.; Prince Albert, Sask.

1. Through Weldwood of Canada.
2. Mircor Inc. was set up to buy 55.25% of Donohue stock from Dofor (a government body). British Printing owns 49% and Quebecor owns 51% of Mircor.
3. Proposed venture combining existing Howe Sound Pulp Div. and Oji investment in newsprint mill.
4. West Fraser Timber Co. is majority-owned by Ketcham family of U.S.
5. Weldwood acquired 100% of Champion Forest Products (Alberta) Ltd.'s mill at Hinton, Alta., early in 1988, at which time Champion's interest in Weldwood increased from 71.8% to 84.6%.

had acquired another 1.5 million common shares of Abitibi-Price, raising its stake to about 74.8% of the company's common shares as of Jan. 11, 1988. Its stake increased to 80.5% by March 1989, and to about 84% by October.

While acquisitions proceeded at a hectic pace throughout 1988, other companies went looking for buyers. After several attempts to sell Manfor Ltd. in 1980, the province of Manitoba put the company back on the block in January 1988. Because of better markets and the company's improved financial condition, the province was confident it would find a buyer for the 150,000-tpy unbleached kraft market pulp and paper mill at The Pas, Man. Conditions were placed on the sale, such as further investment, employment, and use of resources.

In early 1989, Repap Enterprises agreed to acquire Manfor in a deal valued at C$132 million. Repap paid the Manitoba government $40 million in cash and $92 million in preferred Repap shares redeemable at the company's option. Plans were to convert and expand the kraft packaging mill to produce bleached kraft market pulp, but that $200-million project was later shelved indefinitely.

Probably the biggest ownership upheaval of 1988 was the merger of Great Lakes Forest Products Ltd. with CIP Inc., creating the second-largest North American producer of pulp and newsprint. In June, shareholders approved the joining of the two Canadian Pacific Ltd. subsidiaries. The new company, Canadian Pacific Forest Products Ltd., is headquartered in Toronto, Ont. CP's 54.3%-held GLFP unit issued about 24.4 million common shares to CP in exchange for all of the shares of the wholly owned CIP, giving CP about 79.9% of the merged company in a deal valued at C$1.26 billion.

A year later, Normick Perron Inc., eastern Canada's top lumber producer and a partner in the Donohue Normick newsprint mill at Amos, Que., offered a 41% majority stake held by brothers Michel and Jean Perron. Tembec appeared to be the successful bidder, with an offer valued at C$132 million. However, Maclaren Industries Inc., a 24% equity owner, later exercised its right of first refusal and paid about $120 million for that block of shares. Noranda Forest Inc., which owns Maclaren, was expected to gain control of Normick Perron and operate it as part of Maclaren. One of the deal's attractions for Maclaren was the timber resources. Meanwhile, Tembec acquired three Ontario sawmill operations from G.W. Martin Lumber Ltd. of Hartcourt, Ont.

Consolidation continues. In January 1989, West Fraser Timber Ltd. entered the paper business by acquiring a 50% interest in Alberta Newsprint Co. Ltd., a joint-venture firm that is constructing a 220,000-tpy greenfield newsprint mill at Whitecourt, Alta. Scheduled to start up in August 1990, the C$379-million mill is also the province's first papermaking venture. MacMillan Bloedel has agreed to market the output.

Later in 1989, Scott Paper Ltd., the Canadian affiliate of Scott Paper Co., reached an agreement to buy E.B. Eddy Forest Products Ltd.'s White Swan Tissue Div. at Hull, Que., for approximately C$110 million. This marked Eddy's exit from the tissue business.

Ending a long feud over control of the company, Kruger Inc.'s chairman Joseph Kruger II and his family paid C$100 million for a 32% stake in the company held by Bernard Kruger and his four children. The offer was extended to include buying out the remaining outstanding shares, amounting to a 6% interest, at $22 each.

In the last quarter of 1989, Doman Industries Inc. increased its stake in Western Forest Products Ltd. to 56%. The C$137-million deal included an option to buy the remaining 44% interest held by Toronto-Dominion Bank and Royal Bank of Canada. In the two-step transaction, Doman bought out International Forest Products Ltd.'s 21% stake in WFP, while WFP bought back a 23% interest held by Fletcher Challenge Canada. The FCC stake was cancelled, raising the WFP stakes held by the remaining owners. This made Doman the tenth-largest integrated forest products company in Canada. The two banks were left with a 44% stake in WFP.

Canada:

LABOR

Canadian paper mills in the West will have a quiet year in 1990 after reaching a three-year agreement in 1988, but a large number of mills in the East will return to the tables to negotiate a new contract when their agreement settled in 1987 expires. The Canadian Pulp & Paper Assn. (CPPA) calendar shows that a large percentage of the existing contracts in that region will expire on April 30, 1990.

Industry observers believe the Canadian Paper Union (CPU) will approach the talks fully armed. Jim Kelertas, industry analyst with ScotiaMcCleod, said unions in the East will be "tough because they didn't have a great settlement in 1987. This will be especially true after seeing the West settle so well." The agreement reached by CPU and Abitibi-Price Inc. (the target company selected to act as a "model" for the rest of the companies) in 1987 called for wage increases of 25¢/hour the first year, 45¢ the second year, and a 4.5% increase in the third year.

James Buchanan, who was president of CPU until midsummer 1989, believes that the union will approach the discussions aggressively "because I think that we have been very realistic over the last three or four contracts as far as our wage demands are concerned." He also feels that the union has been patient with the industry, which, after coming off another year of top profits, "may cry that it's a cyclical industry and they're going into a low ebb, but that's not going to cut much ice with us because of the cooperative attitude we've had in the past."

How the unions in the East fare in 1990 will also depend on the economic climate in Canada. Although CPU's Buchanan believes that the profit structure is in place, other analysts expect a downturn in the early 1990's that could result in some hesitation on the part of industry.

In fact, the increasing value of the Canadian dollar and possible glut in the newsprint market has made the industry nervous, according to some observers. Jim Rowland, editor of *Canadian Paper Analyst*, said the inevitable downturn in the newsprint market could set the stage for a standoff. He said that most companies with heavy exposure to newsprint

CANADIAN PAPER WORKERS UNIONS

Union	Region represented	Number of members	Number in primary pulp and paper
United Paperworkers International Union (UPIU)	Canada	2,300	n.a.
Canadian Paperworkers Union (CPU)	Canada	70,635	43,515*
	Maritimes	13,893	8,356*
	Quebec	24,862	13,596*
	Ontario and Manitoba	22,202	13,540*
	Saskatchewan, Alberta, and British Columbia	9,678	8,023*
Pulp & Paper Workers of Canada (PPWC)	Western Canada	7,300	5,500

n.a. = Not available.

Note: Pulp and paper workers are also represented in Canada by such major unions as the Confederation of National Trade Unions, International Assn. of Machinists & Aerospace Workers, International Brotherhood of Electrical Workers, and others.

and some with exposure to packaging will approach negotiations tentatively. "I would think that as they go into bargaining at the beginning of 1990, industry earnings could be lower still after dropping in 1989—depending on economics and the currency—and that this could make for a difficult [bargaining] environment."

Several factors will determine whether or not a downturn in the economic cycle will lead to strained negotiations, but the agreement reached in the West in 1988 marked the second consecutive contract the British Columbian industry had reached without any major disruptions.

In July 1989, CPU members held a convention in Quebec City, Que., to elect new officers and to reaffirm tactics for the January 1990 convention when the union will discuss bargaining strategy. Don Holder, formerly vice president of CPU's Ontario region, was elected president at the convention. "We will be aggressive on two major fronts," Holder said. "There will be absolutely no concessions in the bargaining in 1990. We have a very firm policy [about concession bargaining], and our national convention reaffirmed that. We've negotiated long and hard for the benefits we have today, and we do not intend to give them up." Holder also said the union will not tolerate strikebreaking and the permanent hiring of "scab" workers.

Historically, the main sticking point between labor and the industry has been job security. Retired CPU president Buchanan again believes that this will take center stage in negotiations. Because the average union member in the East tends to be older than his or her counterpart in the West, Buchanan said previous negotiations have centered on improving pensions. "We're one of the first ones to bring down an early retirement, and we've paved the way through negotiations to take care of a lot of modernization through attrition to the extent that people have gone out at an earlier age," he said.

The West will not have to renegotiate a contract until 1991. In British Columbia in July 1988, the CPU and Pulp & Paper Workers of Canada (PPWC) voted 71% in favor of a three-year agreement that called for a C85¢/hour increase in the first year and a 5.5% hike in both the second and third years, bringing the average straight-time wage rate to C$20.075/hour on July 1,1990.

The settlement was considerably higher than the one reached in 1987 by most mills in eastern Canada. If British Columbian producers had settled for a similar schedule of increases, the two regions' wage rates would have been closer together. This new settlement, however, widened the gap. By mid-1989, the base wage rate in the East will be about C$15.67/hour compared with C$16.17 in the West. In 1987, the rates were C$14.36/hour in the East and C$14.48 in the West.

Industry observers expected the benefits package to add another 1.5% annually to the cost of the agreement. All told, the new labor contract was expected to run the industry 20% or more in additional labor expenses over the next three years.

In terms of pensions, the contract contains a bridging formula worth C$15/month per year of service, which will make pensions at age 63 comparable to what workers are now getting at age 65. In eastern Canada, workers with 20 years of service are eligible to retire at age 58.

Eric Mitterndorfer, president of Pulp & Paper Industrial Relations Bureau (PPIRB), said, "If you look at what the unions in the West have been doing against inflation over the past three agreements, you'd say that the deal, although probably not rich by U.S. standards, was not inflationary." He also said that negotiations in 1991 will be driven by economics and the realities of supply and demand.

As the Canadian dollar continues to rise and inflation continues to increase, the traditional gap between wages in the East and the West will also expand. Jim Rowland of *Canadian Paper Analyst* believes that

CANADIAN PULP AND PAPER EMPLOYMENT AND EARNINGS

			Yearly change		% change	
Year	Employees	Salaries/ wages	Employees	Salaries/ wages	Employees	Salaries/ wages
1987	80,334	3,113,977	764	114,745	1.0%	3.8%
1986	79,570	2,999,232	2,008	188,431	2.6	6.7
1985	77,562	2,810,801	-1,842	171,996	-2.3	6.5
1984	79,404	2,638,805	240	110,451	0.3	4.3
1983	79,164	2,528,354	-3,940	86,228	-4.7	3.5
1982	83,104	2,442,126	-4,778	132,324	-5.4	5.7
1981	87,882	2,309,802	1,010	260,059	1.2	12.7
1980	86,872	2,049,743	-179	202,615	-0.2	11.0
1979	87,051	1,847,128	1,450	150,359	1.7	8.9
1978	85,601	1,696,769	1,068	155,414	1.3	10.1
1977	84,533	1,541,355	-2,462	125,511	-2.8	8.9
1976	86,995	1,415,844	2,949	324,168	3.5	29.7
1975	84,046	1,091,676	-2,157	-5,422	-2.5	-0.5
1974	86,203	1,097,098	6,118	212,856	7.6	24.1
1973	80,085	884,242	1,116	75,373	1.4	9.3
1972	78,969	808,869	-428	63,261	-0.5	8.5
1971	79,397	745,608	-974	44,213	-1.2	6.3
1970	80,371	701,395				
Average						
1981-84			-1,867	147,016	-2.2	6.6
1976-80			565	191,613	0.7	13.7
1971-75			1,162	86,517	1.5	10.3

Source: *Statistics Canada.*

instead of trying to fight both of these elements in order to balance the wage scale, the unions in the East will want to maintain the traditional differential.

The sluggish newsprint market is also causing concern. Despite the fact that pulp is the major product in the West, Mitterndorfer believes that the capacity coming online in the next couple of years could be reflected in the 1991 labor contract. "We need to stay competitive, and in the long term, that's what's going to drive our bargains," he said.

The 1988 settlement in the pulp and paper mills set the stage for a new contract with woodworkers in British Columbia, represented by the International Woodworkers Assn. (IWA)-Canada. In August 1988, about 18,000 members of IWA-Canada ratified a three-year contract with increases of C85¢/hour in the first year and a 5.5% increase in each of the remaining two years. The settlement affected about 80 companies in British Columbia and covered workers in sawmills, logging operations, and wood manufacturing. Retroactive to June 15, 1988, it lifted the base wage rate from C$14.80/hour to about C$15.65 for the year.

Negotiations in 1988 were more amenable than those in 1986, when woodworkers struck for four-and-a-half months. The strike was over shift flexibility and contracting out. In the 1988 contract, IWA agreed to allow the industry to adjust work schedules outside of strict time frames without paying overtime or dealing with other impediments. In return, the industry agreed not to contract out work without first consulting the union and determining whether the work can be performed by union members.

EMPLOYMENT

Wages and salaries in the Canadian pulp and paper industry increased an average of 10.3%/year during the early 1970s. Employment rose during the period at a 1.5% annual pace, or just under 1,200 new workers each year. As inflation climbed in the late 1970s, wage increases hit a 13.7%/year pace.

With the back-to-back recessions of the early 1980s and the subsequent collapse of inflation, the 1981-84 period brought hard times to the industry. Wage and salary increases slowed from 12.7% in 1981 to only 4.3% in 1984, while employment shrank 2.2%/year during the period. Nearly 9,000 workers lost their jobs during the 1982-83 downturn, as employment decreased by over 10%. To put that number into perspective, the severe recession of 1975 caused a mere 2.5% reduction in employment, according to *Statistics Canada*.

The industry rebounded in 1985, and salaries improved by 5.5% between 1985 and 1986. The number of employees dropped by only 3 people during that period.

Unions in the Canadian pulp and paper industry tend to wield more bargaining power than their U.S. counterparts because of a highly centralized bargaining pattern. Unions also benefit from certain prolabor government policies, such as one prohibiting companies from operating mills during walkouts. However, recent contract settlements indicate that the Canadian unions are scaling back their demands in view of the industry's willingness to take downtime rather than agree to costly contracts.

The bargaining focus in Canada usually alternates between the East and the West. Until 1984, both regions tended to negotiate two-year contracts expiring in the West in odd years and in the East in even years. In 1984, however, both regions approved three-year contracts, with the West's agreement expiring in 1986 and with most contracts in the East lapsing in 1987.

On the West Coast, most companies belong to bargaining groups called Forest Industrial Relations Ltd. and PPIRB, which act as industry-wide bargaining agents. The former group bargains for the timber sector of the industry, while the latter handles paper industry negotiations. In eastern Canada, the industry does not bargain collectively except for four companies—Domtar Inc., Reed Inc., Quebec & Ontario Paper Co. Ltd., and James Maclaren Industries Inc.—which refer to their consortium as the Eastern Canadian Newsprint Group.

CANADIAN UNIONS

The largest union in the Canadian pulp and paper industry is CPU, which has 70,635 workers. About 13,900 members work in the Maritime provinces, 24,860 in Quebec, 22,200 in Ontario and Manitoba, and 9,680 in the West.

Another major Canadian union, PPWC, has about 7,300 members, most of them in British Columbia. The United Paperworkers International Union (UPIU), the majority of its membership in the U.S., represents about 2,350 workers in Canada. CPU broke off from UPIU in the 1970s.

Traditionally, Canadian unions have staged prolonged strikes, ranging from several weeks to several months, in order to attain contract demands. In 1981, a six-week strike by 60,000 members of CPU, PPWC, and IWA shut down the entire British Columbian forest products industry. The strike cost companies an estimated C$18 million/day in sales revenue, while employees lost in excess of $8 million/day in earnings.

In eastern Canada, the industry's unions usually target a major company with which to work out a labor contract and then use it as a role model in negotiations with other companies bargaining that year. Because it is the largest paper company in eastern Canada, Abitibi-Price Inc. traditionally has been the union's target. In 1975, Abitibi mills were closed during a seven-month strike by CPU. In 1980, the union again struck Abitibi, but for only five weeks. That same year, Domtar mills were struck for seven months.

In other labor action in Canada, Corner Brook Pulp & Paper Ltd.'s 820-metric-tpd newsprint mill in Corner Brook, Nfld., was idle for a month in September 1988. About 650 members of the CPU struck the mill on August 22, idling the mill and stopping work on the rebuild of its No. 7 newsprint machine. Workers returned on September 22 after ratifying a two-year contract.

At St-Raymond Paper Inc. in St-Raymond, Que., management asked 250 union members to extend their current contract one year after it expires on Oct. 31, 1989, because of financial difficulties brought on by the high cost of pulp and by expenses incurred from mill upgrades.

Canada:

TIMBER RESOURCES AND PULPWOOD CONSUMPTION

The Canadian forest resource contains a wood volume of about 23 billion m³, according to the Canadian Forestry Service. Of this volume, about 77% is coniferous and 23% is deciduous. Spruce, pine, balsam fir, and aspen/poplar are some of the predominant species groups. Canada has 2.4 million km² of inventoried productive forestland, of which 80% is provincially owned, 11% is federally owned, and 9% is privately owned.

Of the productive forestland, 24.3% is immature, 58.8% is mature, and 9.1% is overmature. Less than 1% is regeneration, and 7.0% is unclassified. The Canadian Forestry Service conducts a national survey of the country's forests every five years. The last one was done in 1986.

CANADIAN PULPWOOD CONSUMPTION

(000 m³)

Year	Roundwood	Total wood residue	Total wood
1987	45,539	56,431	101,970
1986	45,483	46,664	92,147
1985	44,115	45,180	89,295
1984	42,597	44,204	86,801
1983	39,755	43,353	83,108
1982	38,926	37,015	75,941
1981	44,717	39,669	84,386
1980	44,462	41,674	86,136
1979	44,910	41,054	85,964
1978	43,824	37,590	81,414
1977	42,042	33,913	75,955
1976	42,056	34,840	76,896
1975	39,503	24,056	63,559
1974	50,858	30,301	81,159
1973	47,795	27,986	75,781
1972	46,516	23,891	70,407
1971	45,245	20,968	66,213
1970	48,339	17,387	65,726

Source: *Statistics Canada.*

According to the Canadian Pulp & Paper Assn., natural and artificial regeneration of trees are about equally balanced in Canada. Some species, such as balsam fir, regenerate naturally. Spruce usually needs help to regenerate. In 1960, 10 million seedlings were planted in Canada. By 1980, this number had increased to 245 million, and by 1988, a level of 800 million was reached.

However, the amount of old growth timber is declining. On the western coast of British Columbia, some forestry experts estimate that there may be as little as 16 years' worth of original growth timber to harvest, while the most optimistic projections suggest the supply will be exhausted in about 30 years. Nationwide, the federal Ministry of Forests calculates that one-tenth of Canada's 941,000 square miles of potentially productive forestland is "not satisfactorily restocked." This means there is no second generation of trees to replace those that have been harvested. Forestland in this category is growing by about 826 square miles annually.

Meanwhile, the federal government is scaling back its expenditures on federal-provincial forestry resource development agreements (FRDAS). The agreements, started in the early 1980s, are the main funding vehicle for reforestation and silviculture. The federal government in Ottawa has separate agreements with each province, and it began reevaluating those FRDAS in spring 1989. Nearly C$420 million worth of FRDAS expired on Mar. 31, 1989. These involved three- to five-year agreements with six provinces: Nova Scotia, New Brunswick, Ontario, Manitoba, Saskatchewan, and Alberta.

A C$300-million FRDA for British Columbia, another C$300-million FRDA for Quebec, and a C$48-million FRDA for Newfoundland expire Mar. 31, 1990. Ottawa has made no secret of its intention to make the provinces foot more of the bill for the FRDAS. A cut in funds available for reforestation will mean that harvests in the early 1990s will be even smaller than anticipated. There is already a large backlog of land that was logged or burned by wildfire before 1982 and has yet to be reforested. The backlog was slated to be resolved by the year 2000, but that may not be possible if the federal government withdraws some of its funding.

Under the federal budget settled in April 1989, excluding FRDAS, the Forestry Dept. was given C$207 million to spend in 1989—a C$28-million drop from 1988, when forestry was handled by Agriculture Canada. One reason the federal government feels justified in asking provinces to spend more is that provinces received extra tax money because of higher stumpage fees brought about by the softwood lumber dispute with the U.S.

Turmoil in B.C. British Columbia has been wrestling with a provincial proposal to privatize the management of its forests by converting existing timber-cutting rights to tree farm licenses (TFLS). TFLS allow a company to be the sole occupant of a specific area and provide exclusive rights to cut timber for 25 years. The company is responsible for reforestation and management of the area. The major forest products companies in the province are very enthusiastic about the idea because they feel it will give them a more secure timber supply. They have filed numerous requests for TFLS.

The province proposed the TFL program because it wants to reduce its costs. However, some members of the public feel that the province is abdicating to forest products companies its responsibility to manage the forests. They requested that a royal commission be established to investigate the industry.

In response, in late June 1989 the British Columbia Ministry of Forests set up a ten-member commission to help it manage the forestland. The Forest Resources Commission is a permanent agency that began operating out of Vancouver, B.C., in September 1989. It reports directly to Forests Minister David Parker, and it reviews issues assigned by him. The first matter it will address is the TFL proposal. Parker announced in July that the replacement of existing tree farm licenses would be deferred for up to two years to allow the commission to study the issue. The commission will also recommend ways to improve public participation in forest planning and management, and it will review and recommend ways to improve forest harvest practices, focusing on clear-cutting. Clear-cutting is the usual logging technique in the province.

Another quirk in British Columbian forest management plans is the fact that Natives have made unsettled claims to the land. In June 1989, the province's highest court upheld an earlier court decision that prevented Westar Timber Ltd. from proceeding with logging plans in virgin forest north of the Babine River. The British Columbian government has refused to acknowledge or negotiate claims of aboriginal land rights. As a result, apart from a few colonial treaties on southern Vancouver Island, all of the province is subject to aboriginal land claims. The attorney general of the province, who sided with Westar in the suit, said the ruling could open the floodgates to Native Americans with similar

RECEIPTS OF WOOD RESIDUE

(000 m³)

Province/area	Jan.-Apr. 1989	1988	1987
Atlantic provinces	982	2,776	3,366
Quebec	5,483	17,418	16,746
Ontario	1,928	5,655	5,351
Prairie provinces	805	2,499	2,445
British Columbia	8,872	27,924	28,524
Total	18,070	56,272	56,432

Note: Data for British Columbia represent receipts of pulpwood because data on production of pulpwood, as such, are not available.

Source: *Statistics Canada.*

PULPWOOD RECEIPTS FROM ALL SOURCES

(000 m³)

Province/area	Jan.-Apr. 1989	1988	1987
Atlantic provinces	3,447	11,784	10,147
Quebec	3,661	12,643	12,437
Ontario	4,302	12,110	12,722
Prairie provinces	1,789	4,122	4,012
British Columbia	1,323	6,145	6,221
Total	14,522	46,804	45,539

Note: Data for British Columbia represent receipts of pulpwood because data on production of pulpwood, as such, are not available.

Source: *Statistics Canada.*

CONSUMPTION OF ROUNDWOOD AND WOOD RESIDUE

(000 m³)

Province/area	Jan.-Apr. 1989	1988	1987
Atlantic provinces	5,615	14,144	13,515
Quebec	9,917	28,876	27,942
Ontario	5,812	17,505	17,626
Prairie provinces	2,132	6,571	6,505
British Columbia	11,051	33,281	32,950
Total	34,527	100,377	98,538

Source: *Statistics Canada.*

injunction applications.

As is true in the Pacific Northwest of the U.S., preservationists in British Columbia are trying to curtail and in some cases prevent logging. MacMillan Bloedel Ltd. faces such a dispute in the Carmanah Valley on Vancouver Island, where it holds the cutting rights to supply its Port Alberni pulp mill. Some of the trees in the valley are about 500 years old. Although MB has said it will not log all of the old trees, preservationists want the entire valley to be declared a wilderness area. Preservation groups have targeted 13% of the province for parks—up from the current level of 5%. An even bigger confrontation is expected in a few years over cutting rights on Vancouver Island's western coast near Clayoquat Sound.

Sawmills in British Columbia are not in dire straits like sawmills in the Pacific Northwest because the province charges a log export tax equal to 100% of the export price premium, comparing export log prices with domestic. This tax was 40% until it was lifted to 100% in early 1989. In 1990, when the tax is fully implemented, log exports are expected to drop 50%, and they will fall again in 1991.

MB was fined C$1.6 million in 1988 for wasting timber in the Queen Charlotte Islands, and Fletcher Challenge Canada Ltd. was also found to be wasting timber. In July 1989, Forest Minister David Parker instituted a new "zero waste tolerance" wood-use policy for coastal British Columbia timber harvesting. All waste will be measured, and where usable wood has been left on the ground, the company will be fully charged for the stumpage value of the wood, and the volume will be counted against its allowable annual cut. The policy will make it more cost-effective for pulp mills to use pulpwood logs instead of sawlogs.

The future of forestry practices in Ontario is being hashed out in public hearings that began in May 1988. Under examination is the province's forestland management. At mid-1989, the Ministry of Natural Resources had already spent more than C$6 million preparing its case and holding hearings in Thunder Bay. The hearings are expected to end in 1991.

Independents vs pulp mills. In May 1989, about 12,000 sawmill workers in Quebec agreed to a week-long lockout organized by independent sawmill operators to protest the price they were being paid by pulp mills for woodchips. The lockout was staged to force the provincial government to set a guaranteed chip price. The independent sawmillers said they cannot operate unless they are paid at least C$125/metric ton of woodchips; they were getting about $106/ton. Quebec Forestry Minister Albert Cote refused to set a price for chips, saying that the market should determine the price.

Instead, Cote and Quebec's Industrial Development Society put together an aid program to help only those independent sawmills suffering from competitive problems. The program consists of loans to cover 80% of immediate financial needs. Cote also suggested that the forestry ministry would assist sawmills in setting up a joint agency to sell chips.

Pulp mills reportedly now control about 70% of woodchip production in Quebec. The independents, which are prohibited by law from exporting chips, say they have been subsidizing pulp mills. The woodchip price in Quebec rose from C$80 to $100/ton in early 1988.

Sawmills in British Columbia have also complained that they bear a disproportionate part of production costs and receive an unfair share of revenue compared with pulp and paper companies. A 1989 study prepared for the Council of Forest Industries of British Columbia by Price Waterhouse found that the return on capital investment in pulp mills was 30.1% in 1988, an 8% increase from 1987. Profits on lumber, however, dropped to 16% of what they were in 1987. One of the main reasons for this discrepancy is the fact that stumpage costs have risen because of the softwood lumber agreement with the U.S.

The price of raw materials has not risen proportionate to the price of pulp. In 1978, pulp mills paid about 14% of the selling price of pulp for wood; today they pay about 9%. The large integrated companies that own pulp mills have rights to an estimated 85% to 90% of the provincial timber supply. In some cases, they can substitute whole logs for sawmill residue, keeping the chip price down. There has been talk that British Columbia may institute a tax on chips in order to force pulp mills to offset the higher stumpage costs that sawmills are encountering.

Canadian pulp mills have been assiduously acquiring independent sawmill companies to further guarantee their chip supplies. Companies in Quebec that did so in 1989 include Domtar Inc., Tembec Inc., and Donohue Inc. In British Columbia, Canfor Corp. spent C$93.75 million to buy Balfour Forest Products Inc., ensuring the woodchip supply for its two pulp mills in Prince George.

Softwood lumber pact onerous. In October 1986, the U.S. International Trade Administration imposed a 15% ad valorem duty on softwood lumber shipped from Canada to the U.S. Lumber producers in the U.S. had long claimed that the fees Canadian lumber companies paid to provinces for cutting timber were too low and that the government was essentially subsidizing producers.

The U.S. dropped the duty when the Canadian federal government imposed a 15% export fee on its softwood lumber exports to the U.S. The fee was gradually eliminated for provinces that increased stumpage fees for logs cut on government land.

In spring 1989, Trade Minister John Crosbie proposed to Canada's House of Commons that changes be made in the U.S.-Canada agreement on softwood lumber, although he did not specify what changes. He noted that since the agreement was concluded, softwood lumber prices have weakened and the Canadian dollar has risen against the U.S. dollar. The Bush Administration responded by saying it has no intention of reopening the agreement.

Meanwhile, some U.S. and Canadian lumber companies formed a group called the Alliance for Enforcement of the Canadian Lumber Export Tax to prevent companies on both sides of the border from evading Canada's export tax on softwood lumber. Some Canadian companies allege that wood was harvested in British Columbia, which does not have an export tax, but the lumber actually comes from other provinces, and U.S. companies knowingly buy it. The

U.S. Senate Subcommittee on International Trade is also looking into claims made by the U.S. lumber industry that Canadian firms are avoiding the tax.

Alberta's aspen. In order to make better use of their resources, Canadian firms are making more mechanical pulp, which gives twice the yield of chemical pulp. More hardwood is also being pulped. While almost all the softwood timber that is economical to pulp has been claimed, a large amount of hardwood has not been allotted yet, and this was particularly true of Alberta until late 1988.

Alberta has large stands of aspen, and it commissioned a study in 1979 to see if it could get more money for its resource. The estimated value of shipments of paper and allied products from Alberta during 1988 was C$596.5 million—a 7.7% increase over 1987, according to the *Alberta Statistical Review*. Alberta's wood industry, however, still earned more money than its pulp and paper industry in 1988, although it makes lower-value-added products.

In late 1988, Alberta began awarding cutting rights, and currently C$3.3 billion worth of projects are planned for the province. This includes two greenfield bleached kraft pulp mills. Daishowa Paper Manufacturing Co. is constructing a C$500-million, 340,000-metric-tpy hardwood pulp mill at Peace River, Alta., that will start up in 1990. Alberta-Pacific Forest Industries Inc. plans to build a 500,000-tpy kraft pulp mill in Athabasca. Alberta Energy Ltd. plans to build a chemi-thermomechanical pulp mill, while Procter & Gamble Co. plans to expand its kraft pulp mill in Grande Prairie. Two locations in Alberta still could support another pulp mill project. A Taiwanese group has expressed an interest in such a project, but nothing was finalized as of third-quarter 1989.

Canada:

ENERGY USE AND CONSERVATION

Thanks in part to record production levels, Canadian pulp and paper mills used 30.8% less purchased energy per ton of output in 1988 than in 1972, the base year established for comparison purposes by the Canadian Pulp & Paper Assn. In 1988, Canadian mills produced 3.7% more paper and paperboard and 2.3% more woodpulp than in 1987. Newsprint mills—big electricity users—operated at 99% of capacity.

The oil-price shocks of the early 1970s led mills to explore virtually every avenue for relief from skyrocketing energy costs. These efforts, which continued into the 1980s despite lower energy prices, led in two basic directions: process improvements to reduce the energy needed to manufacture a ton of product and alternative energy sources to reduce mills' dependence on purchased power.

Process improvements have included more efficient pressing and drying equipment for paper machines, new heat-recovery equipment, and better refiners. Mills have also been very successful in exploiting waste products as an alternative source of fuel. Woodwaste now accounts for 68% of the total fuel burned by the industry, while waste-fuels plus captive hydraulic power account for 57% of the total energy used, an increase of 42% from 1972.

Electricity, natural gas, and heavy fuel oil are the three major forms of energy bought by Canadian mills, accounting for 96.4% of total purchases in 1988. Electricity accounted for 43.4% of energy purchases in 1988, up from only 24.1% in 1972. Over the same period, oil purchases plummeted by 69.3%—from a 51.1% share of the total in 1972 to only 25.6% in 1988. Natural-gas purchases have been steadier, rising from 20.1% of the total in 1972 to 28.8% in 1988.

PURCHASED ENERGY USE IN CANADA

(gigajoules per metric ton of paper produced)

Year	Electricity	Heavy fuel oil	Distillates	Natural gas	Coal	Other*	Total
1988	5.6	3.1	0.2	3.7	0.2	0.0	12.8
1987	6.0	2.7	0.2	3.3	0.2	0.0	12.4
1986	6.1	2.9	0.2	3.3	0.2	0.1	12.8
1985	5.9	3.2	0.3	3.4	0.4	0.0	13.2
1984	5.7	3.6	0.3	3.5	0.4	0.0	13.5
1983	5.0	4.5	0.2	3.5	0.5	0.1	13.8
1982	5.0	5.6	0.3	4.0	0.5	0.2	15.6
1981	4.8	5.9	0.3	3.9	0.4	0.2	15.5
1980	4.5	6.0	0.4	3.9	0.5	0.2	15.5
1979	4.4	6.5	0.4	4.0	0.5	0.1	15.9
1978	4.7	7.0	0.3	3.9	0.6	0.2	16.7
1977	4.7	7.4	0.4	4.2	0.6	0.3	17.6
1972	4.5	9.0	0.3	3.8	0.7	0.2	18.5

* Purchased steam plus propane.

Source: Canadian Pulp & Paper Assn.

Hydro-Quebec's industrial discount program encouraged greater use of electric boilers in Quebec, and process changes in pulping, air-pollution control, and mechanical paper drying have increased mills' motive power requirements throughout Canada. However, Hydro-Quebec's five-year contract with mills expired in 1988-89, and Hydro has made it clear that the low electricity prices have ended for mills.

This is unfortunate for mills that were encouraged by low prices to install electric boilers. They will have to either pay the higher electricity prices or revert to using more residual oil and natural gas. This shift in consumption use can already be seen in comparisons of 1987 and 1988 data. Another problem faced by mills in Quebec is that electricity generators are making more money by selling their output to users in New England. This competition from the stronger U.S. dollar is also pushing up the price of electricity in eastern Canada.

Mills on Vancouver Island in British Columbia will pay more for energy when a new natural-gas pipeline is completed. In the face of legislation that would have ordered them to buy the natural gas, mills acquiesced to becoming customers of the pipeline.

Patterns of energy consumption differ widely for the Canadian industry's two main products—bleached kraft market pulp and newsprint. According to the Canadian Energy Research Institute, about 70% of the energy needed to make kraft pulp is supplied by process waste and woodwaste, while 3% is purchased electricity. In contrast, purchased energy accounts for over 40% of the energy needed to produce newsprint, and under 20% is recovered in the form of combustible wastes.

In the future, high energy costs could make Swedish newsprint uncompetitive with Canadian newsprint. Partly as a result of the Chernobyl accident, Swedish citizens have decided not to use nuclear power to generate electricity. Nuclear power in Sweden is to be completely discontinued by the year 2010, although it currently generates more than half the country's electricity supply. Two reactors are expected to be decommissioned by the mid-1990s. The official Swedish energy authority, National Energy Board, believes that by 2010, electricity prices will increase by 120%, while prices in Canada will rise only moderately.

In the pollution-control category, the mechanical pulping process avoids the need for recovering and monitoring the sulfur and chlorine now used in chemical pulping. However, the energy needed for mechanical pulping (debarking, chipping, and grinding) is almost all electricity. Mechanical pulp plants are gradually replacing sulfite pulp mills in Canada, particularly in the newsprint sector.

Newsprint can be made entirely from thermomechanical pulp, eliminating the 20% fraction of chemical pulp that formerly went into the furnish. Thermal energy required for thermomechanical pulping, like the mechanical component, is now usually supplied by electricity. In the future, the energy requirement may be met by grinders that can deliver pressurized steam generated by the grinding process itself.

CANADIAN PAPER INDUSTRY CAPITAL SPENDING ON ENERGY AND POWER PROJECTS, 1988-90*

Region	Expenditures (C$000)	% of total energy/power capital budgets
Maritimes	C$19,000	4%
Quebec	142,696	28
Ontario	38,000	8
Central	8,288	2
West	297,845	59
Total	505,829	100
% of total capital spending, all purposes	5.1%	

* Includes projects, as announced, for 1990 and beyond.

Source: *Pulp & Paper* Capital Spending Survey, January 1989.

CANADIAN PULP AND PAPER INDUSTRY PURCHASED ENERGY CONSUMPTION

Energy source	1972[1] joules x 10^{15}	% of total	1986[2] joules x 10^{15}	% of total	1987[2] joules x 10^{15}	% of total	1988[2] joules x 10^{15}	% of total
Coal	16.55	3.5%	5.97	1.9%	4.77	1.5%	4.85	1.5%
Petroleum products								
Residual oil	235.26	49.3	69.97	22.4	69.01	21.6	81.92	24.2
Distillates	8.71	1.8	4.96	1.6	4.72	1.5	4.76	1.4
Natural gas	95.70	20.1	80.74	25.9	85.26	26.7	97.58	28.8
Liquified petroleum gas	0.95	0.2	0.73	0.2	0.78	0.3	0.89	0.3
Other	4.92	1.0	1.50	0.5	1.65	0.5	1.40	0.4
Electricity (purchased)	115.09	24.1	148.42[3]	47.5	152.79[4]	47.9	147.09	43.4
Total	477.18	100.0	312.29	100.0	318.98	100.0	338.49	100.0

1. Reported on 1972 unit use adjusted to 1987 production.
2. Actual use.
3. 31.75 x 10^{15} joules (10.8%) used in electric boilers.
4. 32.91 x 10^{15} joules (10.3%) used in electric boilers.

Source: Canadian Pulp & Paper Assn.

Canada:

TRANSPORTATION

Transportation remains one of the significant costs in delivered prices of Canadian forest products—from 10% to 13% of the final selling price, according to the Canadian Pulp and Paper Assn. CPPA estimated the cost of shipping products from mill to market at roughly 10% of total sales.

Canada is the world's largest exporter of both pulp and paper. It is estimated that in 1987, 45.6% of pulp exports, 82.6% of newsprint exports, and 75.4% of other paper and paperboard exports were to the U.S. Shipments of pulp and paper are expected to increase 3%/year for the next few years. From 50% to 55% of the industry's U.S.-bound shipments of pulp and newsprint is transported by rail, although ocean transport is the predominant system for shipping forest products.

About 606,000 railcars were loaded with forest products in 1988, down from 632,000 in 1987 and lower than the 608,000 carloadings in 1986. The 1988 estimate, amounting to about 28 million metric tons, represents approximately 16.3% of Canada's total 3.7 million carloadings, according to *Statistics Canada*.

Pulp and paper products accounted for over 229,000 rail carloadings in 1988, up from 212,000 in 1987 and 217,000 in 1986. Pulpwood, including roundwood and chips, filled more than 181,000 railcars in 1987.

For many years, Canada's rail system consisted primari-

CARLOADINGS OF MAJOR CANADIAN RAILROADS, 1978-88

(000 cars loaded)

	1988e	1987e	1986	1985	1984	1983	1982	1981	1980	1979	1978
Pulp and paper	229	220	217	213	211	196	191	219	227	231	228
Pulpwood	181	185	185	192	189	195	180	205	233	233	230
Other forest products	192	223	207	215	211	212	171	205	241	262	289
Total forest products	602	628	608	620	611	603	542	629	702	726	747
All rail carloadings	3,729	3,664	3,546	3,594	3,660	3,210	3,096	3,608	3,796	3,889	3,737
(000 metric tons)											
Pulp and paper	14,071	13,518	12,934	12,437	12,089	10,954	10,338	11,556	11,888	11,917	11,694
Pulpwood	10,430	10,617	10,590	10,806	10,574	11,102	9,960	11,157	12,563	12,550	12,233
Other forest products	11,509	12,386	11,228	11,384	11,048	10,815	8,527	9,713	10,935	11,816	12,864
Total forest products	36,010	36,521	34,752	34,627	33,710	32,871	28,825	32,425	35,386	36,283	36,791
Total traffic loaded	271,018	281,815	237,012	237,874	239,866	206,676	199,436	229,690	236,164	237,380	218,783

e = Estimate.

Source: *Statistics Canada.*

ly of two noncompetitive rail carriers: Canadian National (CN) Railway, a Crown corporation, and Canadian Pacific (CP), which is privately owned. In addition, intermodal competition for pulp and paper has been much less pervasive in Canada than in the U.S., which has several competing rail lines plus various intermodal shipping systems using inland waterways and coastal sea routes.

CP moves about 3.0 million tons of pulp and 2.6 million tons of paper annually, or about 86,000 carloadings. Approximately 80% of the newsprint CP ships from Quebec (Canada's largest newsprint-producing province) is destined for the U.S.

NEW TRANSPORT LAWS

The Canadian government implemented new transport regulations in January 1988. These regulations, affecting first the rail industry and then trucking and water-borne shipping, had several positive effects on shipments of Canadian forest and paper products.

Shippers appear to be the main beneficiaries of the new laws. "There's no question it was a shippers' bill," said George Morris of CP Rail. "There's no doubt in my mind that customers have benefited from lower rates."

Rail is the most affected area. In order to change the noncompetitive Canadian rail system into one more like the U.S., the new laws include three key provisions:

Confidential contracts. Rates used to be set publicly, but now confidential contracts allow rail lines to tailor rates to the specific needs of shippers and to adjust rates in a timely and competitive manner. Each shipper has its own rates, dependent upon a particular cargo and destination as well as the bargaining strength or weakness of the carrier and its customers.

Competitive line rates. Mills on captive lines (only one of the two railroads could serve a mill) formerly paid for shipment to the cargo's destination. Under the new guidelines, shippers can ask railways to quote rates to the next interchange of carriers.

Dispute resolution. Procedures for arbitration of shipper-carrier disputes were improved, as were public-interest appeal procedures. The law provides for legally mandated refunds when a shipper's position is upheld.

The regulations also include one-year interim interchange rates in 1988 and the compilation of a database so that results of the legislation can be reviewed in 1992.

Companion legislation was passed for truck and ocean carriers. Ocean-carrier conferences now have limited ability to negotiate contracts, and individual carriers are allowed more independent action. Before, rates were decided by the conferences, which were exempt from Canadian antitrust laws. These carriers haul mostly pulp and newsprint to offshore customers.

The legislation also provided for periodic review. In 1989, the National Transportation Agency of Canada issued a review of the legislation's first year, concluding that confidential contracts were the major change for rail services.

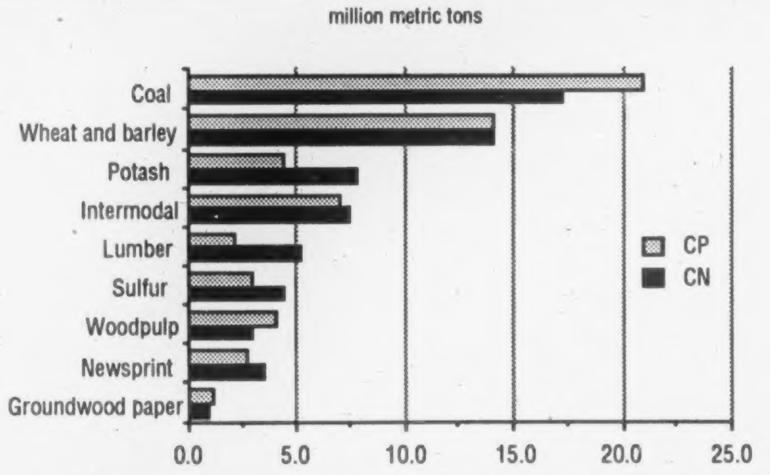
"By year-end [1988], widespread use of confidential contracts had reached levels where one-third of CN's and one-half of CP Rail's traffic (excluding statutory grain) were under contract," the report said. Surveys of rail shippers confirmed the effectiveness of competitive access and dispute-resolution provisions on their negotiations with the railways.

Shipments of pulp and paper products by rail in 1988 were generally buoyed by the strong market. Specifically, the report said that CN tallied more shipments of woodpulp, newsprint, and groundwood papers. CP, on the other hand, saw shipments of woodpulp and newsprint decrease, although groundwood paper traffic grew.

Rail lines are concerned about competition from trucking, though the transport act does help rail compete on pricing. However, both the federal and provincial governments have announced more funding for highways to the obvious advantage of trucking.

Trucking services have not all been as lucky. The annual review said that both shippers and carriers reported increased competition in both truckload and less-than-truckload (LTL) markets. This applies to Canadian domestic markets as well as to transborder markets, and it includes

CANADIAN RAIL TONNAGE BY SELECTED COMMODITY, 1988



Source: National Transportation Agency of Canada (Canadian National and Canadian Pacific annual reports to agency).

increased competition from U.S. carriers. As a result, some Canadian trucking firms are shifting at least part of their operations to the U.S. in order to be more competitive in transborder traffic, the study said.

Increased competition has also meant lower truckload rates, although LTL rates have risen. In fact, the government report said that despite generally good economic conditions in most regions, industry performance in 1988 was not as good as during the previous five years. About 40% of carriers contacted for the study indicated a deterioration in their financial condition compared to the previous year. Of course, rate erosion was not the only factor affecting profits, but it added to the burdens of preregulation developments (acquisitions, mergers, expansions, reorganizations) and other factors.

The industry is watching events with a wary eye. "A lot of what we anticipated happening is happening—it's pretty profitless out there for most guys," said A. Kenneth MacLaren, vice president-government relations for the Canadian Trucking Assn. MacLaren said he expects to see more consolidation, particularly in long-haul. "What we seem to be ending up with are four or five giant national trucker-forwarders."

Canada's experience is not the same as what happened to U.S. trucking after deregulation. It is, however, similar to what happened in Australia when that country deregulated three or four decades ago. There are two major trucker-forwarders in Australia, he said. The benefit is that reduced operating margins have led some carriers to implement more effective cost/pricing systems.

The trucking industry is closely watching how the provinces come to terms with vehicle weights and measures. Provincial governments agreed to a memorandum of understanding that standardizes vehicle weights and dimensions across the country, but problems still exist for interprovincial trucking.

Canadian trucking firms are at a disadvantage compared with the liberal depreciation schedules and lower fuel taxes of their U.S. counterparts. Also, the U.S. implements specific levies for highway use, while Canada's taxes are more general. Other issues will be the difference between Canadian and U.S. regulations for truck entry and the availability of equipment.

WATERBORNE TRANSPORTATION

Another area affected by the legislation is shipping on the Great Lakes package freight. Woodlands Marine, the sole carrier in this respect, competes with CN and CP during the Great Lakes shipping season.

Introduction of confidential contracts has put pressure on prices that Woodlands Marine charges for carrying forest products. Freight tonnages moved by Woodlands, including lumber and forest products, declined slightly in 1988. Woodlands carries lumber and forest products on its southbound main line between Thunder Bay, Ontario, and lower Great Lakes destinations. The report said the use of confidential contracts by the railways kept marine freight rates stable for forest products.

Several years ago, the Canadian government announced its intention to defray transportation costs by charging carriers a portion of the costs for services such as ice breaking, navigational aids, etc. Although this affects all modes of transport, marine carriers are especially affected, according to a paper industry source. For example, mills located near tidewater, some of which use ice breakers, feel these charges would add unfairly to their costs, hurting competition between them and mills that do not use ice breakers.

The free-trade agreement between Canada and the U.S. is likely to most affect trucking. Rail traffic is coast-to-coast and involves mainly pulp and newsprint, which already are duty-free. Also, the agreement makes it easier for American trucking firms to enter the Canadian market.

The relationships between the transportation industry and the forest products and pulp and paper sectors have been warming in recent years. While there still are disputes—or at least polite differences of opinion—most of the problems that arise are fairly small.

Shippers can take certain actions to make it easier for carriers to serve them. CP's Morris said that for rail lines, it is important that mills release rail cars quickly and in clean condition. CP also has its customers complete lengthy questionnaires, interviews individual traffic managers, and tries to improve service in response to those activities.

Harmony is further demonstrated by the fact that shippers have only occasionally taken advantage of the dispute-resolution clause of the new legislation.

Canada:

ENVIRONMENTAL SPENDING AND REGULATIONS

Canadian pulp and paper mills plan to spend C$544 million on environmental-control projects during the 1988-90 period, or about 5.5% of total announced capital expenditures, according to a January 1989 *Pulp & Paper* magazine survey.

Of the announced environmental spending budget, 47.0% is intended to improve water quality, 44.1% to clean up air pollution, and 5.0% to resolve solid-waste disposal problems. The regional breakdown for Canada's environmental expenditures is as follows:

- Water quality: Maritime provinces, 1%; Quebec, 22%; Ontario, 13%; central provinces, 2%; West, 62%.
- Air quality: Maritimes, 0%; Quebec, 18%; Ontario, 1%; central provinces, 2%; West, 80%.
- Solid waste: Maritimes, 0%; Quebec, 25%; Ontario, 17%; central provinces, 1%; West, 57%.

WATER POLLUTION

Canadian mills must spend more on water-quality improvement than they had earlier anticipated because of new regulations promulgated by the provinces after discovery of dioxin in pulp mill effluent and sludge.

In May 1989, British Columbia's Environment Minister Bruce Strachan announced that the 17 pulp mills in the province that use the chlorine bleaching process will have to install secondary wastewater treatment plants by Dec. 31, 1991. Currently, the coastal mills discharge effluent directly into the Pacific Ocean. Strachan also said that the pulp mills must limit their discharges of chlorinated organic compounds, including dioxins and furans, to 1.5 kg/metric ton of pulp by 1994. This is the same level that mills in Sweden will have to meet by 1990. British Columbia is apparently not going to require the mills to install oxygen delignification systems, which the province of Alberta is requiring of its mills.

The cost to British Columbian mills of meeting these requirements is expected to total C$800 million by 1994. This works out to about $47 million per mill, in addition to the $10 million per mill that the Pulp & Paper Research Institute of Canada estimated in late 1988 it would cost to install additional chlorine dioxide generating equipment.

Projects announced since Strachan's statement, however, have come in over C$47 million. For example, Fletcher Challenge Canada Ltd. said it would spend $50 million to

ANNOUNCED SPENDING PLANS FOR ENVIRONMENTAL-CONTROL PROJECTS, 1988-90[1]

(C$000)

Region	Water	Air	Solid waste	Total[2]
Maritimes	C$2,000	0	0	C$2,000
Quebec	57,220	C$42,404	C$6,906	118,530
Ontario	33,653	1,383	4,560	41,282
Central	4,680	4,680	390	9,750
West	158,269	191,609	15,625	372,418
Total	255,822	240,076	27,481	543,980
% of total pollution-control capital spending	47.0%	44.1%	5.1%	100.0%

1. Includes projects for startup in 1990 and after.
2. Includes unspecified spending not shown in subtotals.

Source: *Pulp & Paper,* "Capital Spending Survey: 1988-90" January 1989.

meet the 1.5 kg/ton limit at its 580-metric-tpd bleached kraft market pulp mill in Mackenzie, B.C. Howe Sound Pulp & Paper Ltd., Port Mellon, B.C., will lift its environmental spending by 76% to $88 million. Howe Sound is also installing an oxygen delignification system. Western Pulp Ltd. Partnership, Woodfibre, B.C., will spend $70 million, most of which will go toward a secondary wastewater treatment system. Canfor Corp. announced in June 1989 that it will initially spend $150 million at its two market pulp mills in Prince George, B.C., to install oxygen delignification lines and chlorine dioxide generators.

Alberta is requiring all new or expanding pulp mills to use "leading-edge technology" to control effluent discharges. This includes installation of equipment extending the first delignification stage, installation of an oxygen delignification system, and substitution of between 60% and 70% of chlorine with chlorine dioxide in at least the first stage of conventional bleaching. Alberta is the only province to require oxygen bleaching equipment, a process that the Swedish Pulp & Paper Research Institute said reduces the formation of dioxin.

Daishowa Canada Ltd. is building a 340,000-metric-tpy bleached kraft mill in Peace River, Alta. Procter & Gamble Co. plans to double the size of its Grande Prairie, Alta., bleached kraft market pulp mill. And Alberta-Pacific Forest Industries Inc., a subsidiary of Crestbrook Forest Industries Ltd., plans to build a 500,000-tpy bleached kraft pulp mill near Athabasca, Alta.

These expansion programs have become the centerpiece of political debate within the province. In the last provincial election, Alberta Premier Donald Getty was defeated in his riding, as was Environment Minister Ian Reid. Citizen opposition to the spate of new pulp mill projects and a feeling that the government was not concerned enough about the environment were two of the reasons given for their defeat. Environmental groups are unhappy with the fact that pulp and paper companies seeking to build mills are allowed to perform their own environmental impact assessments, which are then reviewed by the province. Environmentalists want the province to assess the combined effects these projects will have on the province's rivers.

Environmental groups in Alberta, which number about 40 (although there is reportedly a lot of overlapping membership), are meeting opposition from citizens' groups that favor mill construction because of the lift it would give local economies. In June 1989, a group called Friends of the Mill in the Athabasca region sponsored a rally and letter-writing campaign to support Alberta-Pacific's "environmentally safe kraft pulp mill," as they dubbed it. Because of the high level of public interest in the pulp mills, in late June 1989 the Canadian federal government said it would review the permitting process for forestry projects in the Peace River-Athabasca watershed.

While most of the controversy in Alberta has centered on kraft pulp mills, Alberta Energy Co., which is planning to build a 110,000-tpy bleached chemi-thermomechanical pulp (BCTMP) mill near Lesser Slave Lake, Alta., was delayed because five citizens unsuccessfully appealed AEC's development permit on environmental grounds. A public hearing on the project received 430 submissions in favor of the BCTMP mill.

The company said it is considering using ultrafiltration technology, initially developed for nuclear power plants, to reduce the mill's effluent levels. AEC has an agreement with MoDoCell of Sweden for the technology. MoDo has reportedly not tested the technology at its own mills. AEC said the use of ultrafiltration will lower the biological oxygen demand of the mill from 5 kg/air-dried ton of pulp to 3 kg. AEC hopes to introduce ultrafiltration technology in 1993, three years after the mill opens. The technology would reportedly use a filter membrane that blocks chemicals and other suspended particles so small they can only be seen through a microscope. Research is focusing on the membrane and how often it needs to be cleaned.

PROJECTS ANNOUNCED IN BRITISH COLUMBIA DURING FIRST-HALF 1989

Company	Mill	Project	Cost (C$ million)
Canadian Pacific Forest Products	Gold River, B.C.	ClO_2 generators, lime kiln precipitator	C$12
Canfor	Prince George, B.C.	O_2 delignification, upgrade secondary treatment, ClO_2 generators	150*
Fletcher Challenge Canada	Mackenzie, B.C.	ClO_2 generator, expand secondary treatment, screens, washer, boiler upgrade	50
Howe Sound Pulp & Paper	Howe Sound, B.C.	ClO_2 generator, O_2 delignification, secondary treatment	88
MacMillan Bloedel	Harmac, Port Alberni, Powell River, B.C.	ClO_2 substitution, washing	68
Repap Enterprises	Skeena, B.C.	Secondary treatment, ClO_2 substitution	40
Western Pulp	Woodfibre, B.C.	ClO_2 generators, secondary treatment, brownstock washing	70
Weyerhaeuser Canada	Kamloops, B.C.	ClO_2 generators	20

* Spending for both mills in Prince George.

Source: *Pulp & Paper Week.*

Ontario's Environment Ministry announced in April 1989 that the nine kraft pulp mills in the province will have to sharply reduce the amount of chlorinated organics they discharge in wastewater. The ministry will issue control orders during the year. Ontario mills will face even stricter regulations in 1991 when the province issues its Municipal/Industrial Strategy for Abatement. The MISA standards will be based on the best available technology that is economically achievable. A provincial committee recommended that the long-term goal should be complete elimination of chlorinated organic compounds. It also recommended the use of adsorbable organic halogen as a measurement for monitoring.

Canada's federal government may also issue new effluent regulations now that dioxin is known as a byproduct of chlorine bleached pulp. However, the provinces have much more authority to regulate pollution than does the federal government. During 1989, Environment Canada and the pulp and paper industry conducted a national survey of the 47 bleached kraft pulp mills to discover how much dioxin is in each mill's effluent, sludge, and pulp. Until these data are gathered and analyzed, federal limits on dioxin in mill effluent will probably not be promulgated.

In September 1989, the Canadian Pulp & Paper Assn. and Paprican released the results of tests for dioxin in the pulp, effluent, and sludge of 17 pulp mills in British Columbia. Results for the other provinces were released as they became available. The tests were paid for by the pulp mills. Results generally fell within "the range of values reported in the U.S. for mills using similar technology," Paprican said. Organochlorine discharges from British Columbian mills where secondary treatment systems had been installed averaged 3.1 kg/metric ton of pulp. In others, they averaged 6.1 kg/ton.

Dioxin levels were nondetectable in pulp from two mills, and the remaining mills had readings ranging from 0.7 to 26 ppt (parts per trillion). Furan levels were nondetectable in pulp from one mill, and in the rest ranged from 1.8 to 5,200 ppt. For effluent, dioxin was nondetectable at nine mills, while the rest had readings from 7.7 to 400 ppq (parts per quadrillion). Dioxin was nondetectable in sludge from seven mills. The rest had readings from 12 to 130 ppt. A complete copy of the data can be obtained from Paprican, CPPA, or the Council of Forest Industries of British Columbia.

Some industry observers question whether mills have been meeting existing regulations. In March 1989, the environmental group Greenpeace leaked to the media parts of a 614-page study done over three years by Environment Canada. The study concluded that as few as 25 of Canada's 122 pulp and paper mills that discharge wastes into Canadian waterways are likely to be in compliance with federal pollution standards year-round. CPPA responded that although the industry's environmental record is not perfect, it is good.

According to CPPA, between 1979 and 1987, the Canadian industry spent an average of C$160 million annually on pollution abatement. Since the summer of 1988, announcements of planned capital spending for pollution control, including elimination of dioxins and furans, have totaled over $1 billion. In June 1988, a group called West Coast Environment Law Assn. released federal statistics showing that 18 of British Columbia's 22 chemical pulp mills consistently exceeded limits in their discharge permits. In June 1989, the group again released government statistics showing that 17 mills were still in "significant noncompliance" with their water pollution permits.

In June 1989, CPPA released a set of principles established by the industry, including:

- Companies will conduct their business in a responsible manner designed to protect the environment and health and safety of employees, customers, and the public.
- Companies will assess, plan, construct, and operate facilities in compliance with all applicable regulations.
- Forest resources will be managed and protected for multiple use and sustained yield.
- Beyond or in the absence of regulatory requirements, companies will apply sound management practices to advance environmental protection and to minimize environmental impact.
- Companies will promote environmental awareness and report regularly to their boards of directors on their environmental status and performance.
- Industry will work with governments to develop regulations and standards and to support scientific research that it will apply at its mills.

In addition to this blanket industry statement, some paper companies have issued their own environmental policies. Fletcher Challenge Canada issued such a statement in mid-1989, declaring that "in setting higher standards for ourselves in a public document, we are providing an opportunity for people outside the company to measure what we say by what we do." The company also established an employee training and awareness program under the direction of the company's vice president of environment.

The Pulp & Paper Research Institute of Canada, CPPA's research arm, said in mid-1989 that it has spent C$750,000 on research and $500,000 on equipment in each year of a two-year program to determine how chlorinated dioxins and furans are formed and what processing modifications might help eliminate them.

FISH CONTAMINATION

The Fisheries Act of 1970 contains federal water- pollution regulations and guidelines. The act sets limits on dissolved solids for pulp mills built since 1971. It also makes it an offense to deposit any "deleterious substance" in water frequented by fish. Deleterious substance is defined in terms of alteration or degradation of water quality so as to harm fish and impair the use of fish by people.

The presence of high levels of dioxin in shellfish near some coastal pulp mills in British Columbia caused that province to shut down two fisheries in 1988. Samples taken from crabs in waters near Port Mellon, Woodfibre, and Prince Rupert, B.C., contained very high levels of dioxins and furans, a federal study showed in May 1988. And in June 1989, the provincial health minister issued a public health warning advising people who live near six interior British Columbian pulp mills to stop eating certain fish species and to consume only moderate amounts of others. Health & Welfare Canada is conducting a study of fish in the Interior, partially because of complaints by Native Americans living near the mills.

PRODUCT TESTING

Canada has done more testing of milk packaged in solid bleached sulfate (SBS) cartons than has the U.S. A Canadian scientist working for the Food Research Div. of Health & Welfare Canada first discovered that dioxin was present in milk packaged in SBS cartons, based on a very small study done in 1988. In Quebec, a follow-up study of 140 milk samples found trace levels of furans in milk packaged in SBS board.

In April 1989, suppliers pledged to provide to Canada's National Dairy Council SBS board that does not result in any detectable level of dioxins or furans in milk. A nationwide test of milk packaged in cartons was launched in mid-April 1989 in order to verify that mills live up to their promise. The results, expected in six to eight months, will be significant for all of North America because Canada imports most of its SBS from the U.S.

AIR POLLUTION

Tree death in Canada is becoming a grave problem for the nation's forestry industry, especially in the northeastern provinces. A study conducted in Quebec reported that a majority of the province's hardwoods are being weakened by pollution. Air pollution also drives away birds, which control the population of insects that feed on trees. Because Canada claims that about half of its acid rain originates in the U.S., the situation requires the cooperation of its southern neighbor.

In June 1987, the U.S. Supreme Court rejected appeals by eight northeastern states, Ontario, and several environmental groups seeking to force the Reagan Administration to abide by a pollution-control commitment made during the Carter Administration. These groups argued that a letter written by the administrator of the Environmental Protection Agency in 1981, which said that acid rain was "endangering public welfare in the U.S. and Canada," required future administrations to take steps to reduce acid rain.

The only thing that came out of talks between President Ronald Reagan and Canadian Prime Minister Brian Mulroney in early 1987 was a U.S. agreement to "consider" a bilateral U.S.-Canada accord on combating acid rain. Canada wanted a congressionally approved treaty, similar to the one that governs the Great Lakes, with specific timetables and numerical goals for reducing sulfur-dioxide emissions.

One of the election promises made by President George Bush was to enact legislation to improve air quality. In June 1989, he proposed a major revision of the Clean Air Act, which his administration said would reduce acid rain 50% by the year 2000. (For more information on the proposal, see U.S. Environmental Spending and Regulations chapter.) Canada is waiting to see what Congress will do with the proposal, but observers are hopeful that Bush will be able to implement at least part of his program.

The Canadian federal government and the seven provinces east of Saskatchewan committed themselves in February 1985 to cutting acid-rain emissions to half their 1980 levels by 1994. In March 1989, British Columbia prohibited the use of high-sulfur-content fuel. This will put additional pressure on Vancouver Island pulp mills to convert to natural gas after completion of a pipeline to the island.

TOXIC CHEMICALS

On June 30, 1988, the Canadian Environmental Protection Act became law. CEPA gives the Ministry of the Environment authority to control the introduction of substances new to Canada. The act also modernizes and clarifies federal environmental legislation, providing for greater consultation among federal departments, between federal and provincial governments, and with the private sector. The scope of the proposed act is much greater than the Environmental Contaminants Act, which it replaced.

Under the new legislation, industry is required to notify the Minister of the Environment before any chemical is introduced into the country and to submit data describing the chemical's properties so that health and environmental impact assessments can be made. Industry has to provide information on where and how these chemicals will be used. The law requires Canadian firms exporting such chemicals to notify an authority in the countries to which the chemical is being shipped. The penalties for noncompliance include fines of up to C$1 million/day and liability of corporate officers for damages, including prison terms.

Paper:

INTRODUCTION

Paper grades are categorized by their overall end use. Thus, they are broken down into five major groupings: (1) newsprint, (2) printing papers, (3) fine or writing papers, (4) packaging and converting papers, and (5) tissue papers. Newsprint is separated from other printing papers because newsprint mills produce a more basic product than printing paper mills, and because newsprint mills utilize fewer value-added systems such as coaters or supercalenders. Newsprint is the crudest and least expensive publication paper.

Paper grades break down even further according to how they are made and what their specific end uses are. Grade classifications are subject to change and interpretation, especially as new types of furnish and papermaking processes take hold. It is not always easy to separate paper and paperboard grades into their respective groups, particularly with a grade such as bristols, which has basis weights similar to those of paperboard grades.

Factbook relies on classifications established by the U.S. Bureau of the Census and those used by the American Paper Institute and the Canadian Pulp & Paper Assn. These classifications are divided into uncoated free-sheet, which is mostly fine papers and a large volume of printing papers; coated paper, used almost exclusively for publishing and commercial printing; and uncoated groundwood paper. Both coated and uncoated groundwood grades are used for magazines, catalogs, and newspaper inserts, but they are priced substantially apart.

Free-sheet papers, whether uncoated or coated, are made with little or no mechanical (groundwood) pulp. Groundwood papers are often made with stone groundwood or thermomechanical pulp. Included with uncoated free-sheet is cotton-fiber paper, a small part of the fine papers group.

Factbook looks at the eight major subgroupings that are commonly understood and accepted by the paper industry:

- Newsprint
- Uncoated groundwood papers
- Coated papers
- Uncoated free-sheet papers
- Cotton-fiber papers
- Bristols
- Packaging and industrial converting papers
- Tissue

Separate chapters examine detailed production and market distinctions within these categories, along with any important trends in production techniques or end uses.

Paper grades are usually produced on fourdrinier paper machines or twin-wire formers, but in a few cases cylinder board machines or multi-ply formers are used. Paper machines exist in many sizes and configurations according to the single grade of paper to be produced, or according to a paper mill's particular requirements for its own product.

The process of papermaking begins with a slurry of fibers and water that is drained (dewatered) on a wire, after which further excess water is removed by pressing and drying. The dried sheet is then wound on a reel from which rolls or sheets of paper are produced. Papermaking is a complex process, combining sophisticated and evolving technology and decades of experience.

Numerous technical reference books exist that discuss papermaking in more detail. The main purpose of this work is to provide the reader with an overall introduction to the most important sectors of the paper industry, with discussions elsewhere in the book of important themes for the entire pulp, paper, and paperboard industry.

No two mills make the same grade of paper by exactly the same method or with the same equipment. For example, one mill may make newsprint on a twin-wire former using 100% wastepaper, while another mill may produce a similar-quality newsprint with a fourdrinier machine and groundwood pulp. Some paper mills are modern, using the most up-to-date, large-scale equipment available, whereas other paper mills make similar grades on small equipment at 100-year-old sites—mills still in operation because they serve a particular market need, and because using entirely paid-for equipment permits them to do so economically.

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-88

(000 short tons)

	1988	1987	1986r	1985	1984	1983	1982
TOTAL, ALL GRADES	37,694	36,199	35,510	33,179	32,989	32,205	30,151
PRINTING/WRITING AND RELATED PAPERS	27,843	26,691	25,448	23,861	23,925	22,662	20,986
Newsprint	5,913	5,831	5,638	5,503	5,620	5,266	5,063
Uncoated groundwood paper	1,667	1,544	1,574	1,564	1,723	1,604	1,499
Publication and printing	1,399	1,363	1,354	1,361	1,488	1,383	1,299
Supercalendered[2]	384	(D)	(D)	(D)	345	394	248
Other	1,015	1,000	1,016	1,004	1,143	989	1,046
Other converting and miscellaneous	126	(D)	(D)	(D)	(D)	(D)	(D)
Body stock for coating	—	(D)	(D)	(D)	(D)	(D)	(D)
Coated printing and converting paper	7,611	7,064	6,521	6,036	6,469	5,852	5,224
Coated groundwood (more than 10% groundwood)	4,088	3,861	3,598	3,384	3,708	3,526	3,115
Coated one side	—	(D)	(D)	(D)	(D)	(D)	(D)
Coated two side	—	(D)	(D)	(D)	(D)	(D)	(D)
Coated free-sheet (10% groundwood or less)	3,523	3,203	2,923	2,651	2,761	2,326	2,109
Coated one side	619	480	482	582	580	472	450
Coated two side	2,903	2,723	2,441	2,069	2,181	1,853	1,659
Prime coated stock for coating	—	—	—	—	(S)	(S)	(S)
Uncoated free-sheet (10% groundwood or less)	11,027	10,777	10,303	9,454	8,726	8,572	7,890
Writing (chemical woodpulp)	6,168	5,934	5,606	5,299	4,992	4,837	4,451
Bond and writing, including protective check	2,847	2,698	2,437	2,316	2,247	2,142	1,946
Forms bond in rolls	2,063	2,017	2,050	1,901	1,744	1,663	1,535
Ledger	68	63	69	66	62	62	60
Mimeograph (all woodpulp furnishes)	28	32	85	76	81	84	80
Gelatin and spirit process duplicating	39	52	144	158	161	191	164
Papeterie and wedding	46	47	47	50	55	47	49
Body stock for communication, copying	341	334	283	237	246	203	174
Other technical and reproduction	371	376	172	176	156	123	115
Tablet	296	266	267	264	185	274	269
Other (onion skin, manifold, etc.)	68	61	53	55	55	49	59
Publication and printing	2,948	2,950	2,852	2,472	2,342	2,193	2,064
Plain (MF, EF, antique, bulking, SC)	335	334	334	266	286	265	217
Offset	2,008	2,011	1,909	1,622	1,551	1,448	1,393
Other publication and printing	605	606	609	584	504	480	454
Cover and text papers	448	411	367	378	386	372	353
Other converting and miscellaneous	1,463	1,481	1,479	1,305	1,006	1,170	1,022
Envelope (white woven)	755	713	714	666	668	627	575
Kraft envelope, bleached and brown	388	374	376	354	(D)	350	304
Coating basestock	320	394	390	—	—	—	—
Bleached bristols[3]	1,218	1,091	973	897	940	928	879
Tabulating card stock	—	(D)	(D)	(D)	68	107	123
Tag and file folder	430	414	389	363	356	364	316
Tag	203	207	212	200	214	215	191
Folder	226	207	178	164	141	149	125
Other uncoated (index, printing, postcard)	345	325	295	268	215	240	234
Coated	443	352	289	266	302	217	205
Cotton-fiber writing paper and thin paper	407	383	439	408	447	440	430
Writing, cotton-fiber	126	121	168	145	144	160	134
Bond and writing	97	94	131	126	125	131	116
Other	29	27	36	19	19	29	17
Thin paper	281	262	271	262	303	280	297
Carbonizing free from groundwood pulp	—	(D)	(D)	(D)	(D)	(D)	(D)
Other[4]	—	(D)	(D)	(D)	(D)	(D)	(D)

continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-88 (continued)

(000 short tons)

	1981	1980	1979	1978	1977	1976	1975
TOTAL, ALL GRADES	29,816	30,164	29,580	28,506	28,906	26,534	23,295
PRINTING/WRITING AND RELATED PAPERS	20,791	20,362	19,271	18,482	17,923	16,784	14,656
Newsprint	5,253	4,660	3,778	3,489	3,525	3,526	3,476
Groundwood paper, uncoated	1,428	1,538	1,800	1,569	1,588	1,460	1,294
Publication and printing	(D)	—	—	—	—	1,301	1,169
Supercalendered[2]	(D)	156	161	324	334	—	—
Other	1,073	1,136	1,420	1,030	1,086	—	—
Other converting and miscellaneous	200	—	—	215	168	158	125
Body stock for coating	(D)	243	220	(D)	(D)	(D)	(D)
Coated printing and converting paper	4,775	4,751	4,580	4,513	4,215	4,063	3,318
Coated groundwood (more than 10% groundwood)	2,646	—	—	—	—	—	—
Coated one side	77	123	118	—	—	—	—
Coated two side	2,568	2,572	2,307	—	—	—	—
Coated free-sheet (10% groundwood or less)	2,129	—	—	—	—	—	—
Coated one side	455	356	364	477	439	—	—
Coated two side	1,674	—	—	—	—	—	—
Prime coated stock for coating	(S)	1,700	1,791	4,036	3,776	(D)	(D)
Uncoated free-sheet (10% groundwood or less)	7,965	8,008	7,655	7,315	7,036	*	*
Writing (chemical woodpulp)	4,485	4,066	3,815	3,589	3,524	3,094	2,683
Bond and writing, including protective check	1,813	1,616	1,447	1,415	1,322	1,255	1,065
Forms bond in rolls	1,555	1,327	1,330	1,179	1,191	911	892
Ledger	99	107	117	63	67	64	49
Mimeograph (all woodpulp furnishes)	102	98	88	103	119	109	100
Gelatin and spirit process duplicating	178	301	234	196	166	166	147
Papeterie and wedding	61	48	62	55	48	50	37
Body stock for communication, copying	238	356	307	169	171	145	111
Other technical and reproduction	141	122	126	157	153	153	136
Tablet	221	315	299	219	203	225	215
Other (onion skin, manifold, etc.)	77	91	109	250	286	231	197
Publication and printing	2,206	2,127	2,048	2,199	2,082	1,904	1,561
Plain (MF, EF, antique, bulking, SC)	342	(D)	(D)	201	147	154	114
Offset	1,443	1,930	1,837	1,987	1,921	1,737	1,438
Other publication and printing	421	(D)	(D)	—	—	—	—
Cover and text papers	272	263	280	219	196	178	159
Other converting and miscellaneous	1,002	(D)	(D)	1,308	1,234	1,070	840
Envelope (white woven)	547	620	659	609	623	588	474
Kraft envelope, bleached and brown	295	272	205	212	195	—	—
Coating basestock	—	—	—	—	—	—	—
Bleached bristols[3]	904	941	957	1,127	1,108	1,041	936
Tabulating card stock	153	202	217	311	338	354	373
Tag and file folder	311	285	310	313	280	247	221
Tag	176	196	199	214	191	163	148
Folder	135	89	112	99	90	84	73
Other uncoated (index, printing, postcard)	209	222	188	239	232	228	169
Coated	231	232	242	264	258	211	173
Cotton-fiber writing paper and thin paper	466	464	502	469	450	**	**
Writing, cotton-fiber	113	131	130	119	111	103	91
Bond and writing	90	93	91	86	92	76	66
Other	23	7	7	8	7	5	4
Thin paper	353	333	371	350	339	345	311
Carbonizing free from groundwood pulp	(D)	196	238	224	212	198	170
Other[4]	(D)	137	134	126	127	148	141

continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-88 (continued)

(000 short tons)

	1988	1987	1986r	1985	1984	1983	1982
PACKAGING AND INDUSTRIAL CONVERTING PAPER	4,779	4,624	4,643	4,697	4,976	5,097	4,873
Unbleached packaging, industrial converting	2,887	2,790	2,892	3,065	3,377	3,391	3,308
Wrapping	81	(D)	57	77	83	90	85
Shipping sack	734	695	673	755	816	727	787
Bag and sack other than shipping sack	1,523	1,512	1,648	1,712	1,951	1,860	4,154
Specialty packaging (92 lb and under)[5]	70	(D)	61	109	122	326	251
Other converting, including creping (92 lb and under)[6]	480	460	458	412	405	388	331
Packaging, industrial converting, except unbleached kraft wrapping	1,667	1,136	1,023	950	901	902	828
Wrapping (MG and MF butchers, miscellaneous wrapping)	47	47	33	33	50	65	67
Shipping sack, including comb. kraft and rope	220	200	172	118	113	119	105
Unbleached and bleached sulfite, semibleached and bleached kraft; mixtures	—	191	161	108	91	95	(D)
Other shipping sack paper	—	9	11	11	21	24	(D)
Other bag and sack	233	192	204	240	209	168	143
Unbleached and bleached sulfite, semibleached and bleached kraft	163	130	142	170	137	121	105
Other bag and sack paper	70	62	63	70	72	46	38
Other converting (19 lb and over)	197	226	206	178	186	209	183
Waxing stock (18 lb and up)	128	147	148	130	132	157	136
Other, such as asphalting and creping stock	69	79	57	48	51	53	47
Specialty packaging	209	205	192	168	166	132	124
Glassine, greaseproof, and vegetable parchment	261	266	216	212	181	209	206
Special industrial paper	726	697	727	682	697	804	737
TISSUE	5,072	4,885	4,768	4,620	4,089	4,446	4,291
Sanitary paper	4,906	4,740	4,638	4,494	3,953	4,337	4,185
Toilet tissue	1,853	1,798	1,809	1,833	1,490	1,742	1,679
Single-ply	1,109	1,077	1,127	1,198	955	941	962
Multi-ply	744	721	682	635	534	802	717
Facial tissue, excluding toweling, napkin, and toilet	323	301	303	302	285	292	277
Napkin	675	626	595	596	529	594	532
Single-ply	488	432	431	451	401	467	407
Multi-ply	187	194	165	144	128	127	125
Toweling, excluding wiper stock	1,729	1,715	1,644	1,521	1,363	1,449	1,433
Sanitary napkin stock wadding	—	(D)	(D)	(D)	73	99	113
Wiper stock, regular, facial, and wadding type	186	178	156	111	109	60	56
Other sanitary stock	141	122	131	131	104	99	94
Tissue paper, excluding sanitary and thin	166	145	130	126	136	110	106
Wrapping tissue	78	69	59	56	69	(D)	(D)
Waxing tissue stock	—	(D)	(D)	(D)	(D)	(D)	(D)
Creped wadding for interior packaging	—	(D)	(D)	(D)	(D)	(D)	(D)
Other tissue, excluding sanitary and thin	37	28	23	24	31	20	21

continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-88 (continued)

(000 short tons)

	1981	1980	1979	1978	1977	1976	1975
PACKAGING AND INDUSTRIAL CONVERTING PAPER	4,994	5,327	5,708	5,778	5,931	5,727	4,824
Unbleached packaging, industrial converting	3,586	3,718	3,911	3,872	4,061	3,917	3,399
Wrapping	103	137	187	210	218	201	165
Shipping sack	967	1,062	1,110	1,019	1,073	1,102	879
Bag and sack other than shipping sack	2,012	2,101	2,115	2,092	2,212	2,125	1,938
Specialty packaging (92 lb and under)[5]	165	2,074	2,085	2,064	2,182	2,076	1,892
Other converting, including creping (92 lb and under)[6]	340	419	499	551	558	488	417
Packaging, industrial converting, except unbleached kraft wrapping	923	1,145	1,266	1,408	1,346	1,224	985
Wrapping (MG and MF butchers, miscellaneous wrapping)	80	103	119	155	136	134	115
Shipping sack, including comb. kraft and.rope	118	92	102	92	107	120	95
Unbleached and bleached sulfite, semibleached and bleached kraft; mixtures	84	(D)	(D)	(D)	(D)	—	—
Other shipping sack paper	34	(D)	(D)	(D)	(D)	97	69
Other bag and sack	176	229	250	273	304	261	228
Unbleached and bleached sulfite, semibleached and bleached kraft	124	155	170	217	198	140	133
Other bag and sack paper	51	73	80	55	106	121	94
Other converting (19 lb and over)	163	251	287	264	236	407	335
Waxing stock (18 lb and up)	120	98	113	76	69	109	97
Other, such as asphalting and creping stock	42	52	59	—	—	115	94
Specialty packaging	209	269	273	365	344	—	—
Glassine, greaseproof, and vegetable parchment	177	202	234	259	219	202	191
Special industrial paper	485	464	531	498	524	586	440
TISSUE	4,031	4,474	4,601	4,246	4,243	4,123	3,846
Sanitary paper	3,917	4,298	4,403	4,036	4,045	3,930	3,669
Toilet tissue	1,533	1,706	1,772	1,629	1,605	1,566	1,422
Single-ply	944	939	978	939	877	916	328
Multi-ply	588	766	794	690	729	650	594
Facial tissue, excluding toweling, napkin, and toilet	298	370	376	383	365	359	374
Napkin	474	532	533	429	470	448	436
Single-ply	341	409	404	317	353	342	334
Multi-ply	133	123	129	112	117	106	102
Toweling, excluding wiper stock	1,253	1,439	1,482	1,375	1,388	1,326	1,230
Sanitary napkin stock wadding	116	103	98	87	73	73	55
Wiper stock, regular, facial, and wadding type	129	74	63	57	48	67	62
Other sanitary stock	114	74	78	76	96	91	89
Tissue paper, excluding sanitary and thin	114	176	198	210	197	193	178
Wrapping tissue	(D)	72	63	75	74	61	47
Waxing tissue stock	(D)	24	31	32	28	37	39
Creped wadding for interior packaging	(D)	25	41	37	35	30	34
Other tissue, excluding sanitary and thin	25	18	21	29	28	30	22

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.
r = Revised.
(D) Data withheld to avoid disclosing figures for individual companies.
(S) Suppressed because the data did not meet publication standards of the Bureau of the Census.
* "Book paper, uncoated, total." 1976—2,973,891 tons; 1975—2,401,131; 1974—2,831,562.
** "Writing and related papers, not included elsewhere, total." 1976—3,720,678 tons; 1975—3,244,141; 1974—4,101,606.

1. Reported as production by Bureau of the Census prior to 1981.
2. Forms bond included 1984 and 1985 only.
3. Excluding cotton-fiber, index, and bogus.
4. Cigarette, condenser, other.
5. Grocery bag and sack paper.
6. Other unbleached kraft bag paper.

Source: Bureau of the Census.

U.S. PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[2]		
Year	Tonnage	Change (%)	Tonnage	Change (%)	Utilization rate (%)
1991e	41,881	4.6%	44,631	3.5%	93.8%
1990e	40,026	2.7	43,106	4.0	92.9
1989e	38,992	1.9	41,439	3.1	94.1
1988e	38,255	5.9	40,199	2.9	95.2
1987	36,134	3.7	39,080	2.8	92.5
1986r	34,859	5.1	38,014	1.2	91.7
1985	33,179	3.7	37,581	1.3	90.6
1984	32,989	9.4	37,106	4.0	92.8
1983	30,151	-0.9	35,675	2.8	92.4
1982	30,422	2.0	34,696	2.9	87.7
1981	29,816	-1.5	33,706	3.2	92.1
1980	30,281	2.4	32,659	4.7	92.7
1979	29,580	4.7	31,179	2.4	96.3
1978	28,253	0.6	30,460	2.1	93.6
1977	28,096	5.5	29,831	2.1	94.1
1976	26,612	14.1	29,210	0.9	91.1
1975	23,306	-12.6	28,922	1.3	80.5
1974	26,651	0.7	28,532	3.2	93.4
1973	26,483	4.1	27,621	1.7	95.3
1972	25,435	6.8	27,156	3.3	93.6
1971	23,811	0.7	26,270	1.7	90.6
1970	23,625	0.1	25,806	2.1	91.5
1969	23,596	—	25,257	—	93.4
Average 1979-88		3.1%		3.0%	

e = Estimate.
r = Revised.

[1] Bureau of the Census data. Includes newsprint, printing/writing, packaging and industrial papers, and tissue.

[2] American Paper Institute.

PUBLICATION PRINTING TECHNOLOGY PROCESS CHANGES: 1988-90*

	1988	1989e	1990e
Offset	73%	74%	74%
Gravure	27	26	26

e = Estimate.
* = Percentage of use by magazine publishers.

Source: Magazine Publishers of America, "Paper Outlook."

CANADIAN PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[1]	
Year	Tonnage	Change (%)	Tonnage	Change (%)
1988	15,364	4.0%	18,891	2.5%
1987	14,714	5.0	18,209	2.4
1986	13,986	5.0	14,921	3.2
1985	13,298	2.6	14,458	1.3
1984	12,965	3.4	14,270	0.9
1983	12,536	6.5	14,149	1.9
1982	11,772	-6.9	14,012	3.8
1981	12,640	3.6	13,502	4.0
1980	12,200	-0.5	12,975	0.9
1979	12,259	0.9	12,855	2.0
1978	12,148	9.0	12,603	0.9
1977	11,146	3.6	12,493	0.8
1976	10,757	17.1	12,396	1.0
1975	9,186	-22.0	12,275	0.9
1974	11,782	6.0	12,168	-1.0
1973	11,120	3.9	12,292	1.4
1972	10,700	4.7	12,121	—
1971	10,215	-1.4	—	—
1970	10,357	-0.1	—	—
1969	10,372	—	—	—

[1] Includes newsprint, groundwood printing and specialties, book and writing, kraft, tissue and special; excludes building papers.

Source: Canadian Pulp & Paper Assn.

ESTIMATED NUMBER OF MACHINES AND TOTAL CAPACITY IN U.S.—1975 AND 1989

	1989		1975	
	Number	Annual tpy (000 tons)	Number	Annual tpy (000 tons)
Total paper	858	41,439	981	28,922
Newsprint	42	6,301	38	3,848
Printing/writing and related	426	23,971	475	14,274
Packaging/industrial converting	178	5,410	228	6,368
Tissue	212	5,757	240	4,432

Source: American Paper Institute capacity surveys.

PRINTING/WRITING PAPER SHIPMENTS, 1981-88

(000 short tons)

Grade	**1988**	**1987r**	**1986**	**1985**	**1984**	**1983**	**1982**	**1981**
Total uncoated free-sheet[1]	11,277	10,965	10,504	9,750	9,207	8,765	7,907	7,870
Offset[2]	2,918	2,819	2,568	2,377	2,302	2,110	1,981	1,990
Copy/duplicating (BMDX)[3]	3,026	2,872	2,428	2,202	2,071	2,220	1,949	1,911
Forms bond[4]	2,127	2,157	2,135	1,911	1,805	1,700	1,569	1,569
Envelope	943	916	1,103	1,008	1,003	920	863	854
Tablet	379	425	404	435	299	400	325	322
Text and cover	349	329	276	257	265	240	230	239
Other	1,535	1,684	1,590	1,560	1,462	1,175	990	985
Total coated paper[1]	7,360	6,860	6,260	5,875	6,249	5,695	4,980	4,937
Coated one side[2]	418	456	385	369	388	405	395	430
Coated two side Nos. 1-4	3,325	3,390	2,756	2,514	2,669	2,325	1,930	1,990
Coated two side No. 5	3,617	3,758	3,118	2,993	3,192	2,965	2,655	2,517
Operating rates								
Uncoated free-sheet	95.5%	95.5%	94.4%	92.7%	91.5%	94.0%	88.0%	90.0%
Coated groundwood	95.1	91.6	91.6	89.0	94.7	95.0	84.0	91.0
Coated free-sheet	97.0	95.1	94.5	86.6	93.4	95.0	94.0	94.0

r = Revised.
1. American Paper Institute.
2. *Pulp & Paper Week* estimates.
3. Includes bond.
4. Includes carbonless.

CANADIAN PAPER PRODUCTION

(000 short tons)

Year	**Newsprint**	**Groundwood printing/specialty**	**Other book and writing**	**Wrapping papers**	**Tissue/ specialty**	**Building papers**	**Total**
1988	10,989	1,641	1,570	626	538	n.a.	15,364
1987	10,658	1,498	1,430	625	503	—	14,714
1986	10,238	1,346	1,300	596	506	142	14,127
1985	9,907	1,157	1,205	537	493	138	13,437
1984	9,935	1,054	1,122	514	198	134	12,959
1983	9,354	1,046	1,168	535	433	155	12,691
1982	8,947	715	916	499	413	137	11,627
1981	9,866	883	880	577	434	130	12,770
1980	9,507	677	987	613	416	140	12,340
1979	9,551	624	1,008	668	408	138	12,397
1978	9,670	580	871	637	390	142	12,290
1977	8,988	463	759	571	365	155	11,301
1976	8,915	384	544	580	335	165	10,923
1975	7,679	311	437	475	283	161	9,346
1970	8,719	289	616	493	240	101	10,458
1969	8,818	214	544	514	281	116	10,487

n.a. = Not available.

Sources: Canadian Pulp & Paper Assn., *Pulp & Paper.*

VALUE OF SHIPMENTS OF PRIMARY PAPER PRODUCTS

($000)

	1987	1986r	1985	1984	1983	1982	1981	1979	1977	1975
TOTALS[1]	$26,851	$24,783	$24,194	$24,272	$21,399	$19,417	$19,607	$15,784	$12,438	$9,370
Newsprint	2,737	2,413	2,393	2,344	2,122	2,138	2,187	1,226	989	828
Uncoated groundwood	912	925	908	1,043	870	733	765	723	539	403
Publication/printing	809	804	832	901	—	—	—	—	—	—
Coated printing and converting	5,832	5,465	5,426	5,365	4,255	3,799	3,446	2,825	2,261	1,473
Coated groundwood	2,678	2,600	2,791	2,729	2,229	2,000	—	—	—	—
Coated free-sheet	3,153	2,865	2,635	2,636	2,026	1,799	—	—	—	—
Uncoated printing/writing[2]	8,044	7,423	6,704	6,959	5,985	5,463	5,660	4,666	3,353	2,845
Writing, chemical pulp	4,399	3,994	3,741	3,889	3,392	3,107	3,221	—	—	—
Publication/printing	2,164	2,054	1,687	1,784	1,516	1,414	1,521	—	—	—
Cover/text	531	453	468	466	362	320	277	—	—	—
Other	949	922	807	820	715	621	641	—	—	—
Cotton-fiber and thin	683	750	688	732	633	666	696	645	496	—
Bleached bristols	883	696	647	692	640	563	585	502	474	355
Unbleached kraft packaging[3]	1,222	1,102	1,090	1,331	1,190	1,151	1,343	1,244	1,099	873
Packaging and converting[4]	945	821	778	795	717	797	758	760	561	439
Special industrial	1,006	976	968	992	1,011	631	617	575	551	389
Tissue	4,571	4,213	4,593	4,019	3,977	3,679	3,550	2,618	2,116	1,765

r = Revised.

1. Totals are higher than individual values due to inclusion of nonclassified grades.
2. Uncoated free-sheets.
3. Plus industrial converting papers.
4. Except unbleached kraft.

Source: Bureau of the Census.

MARKET INDICATORS FOR PAPER GRADES: ESTIMATED ANNUAL U.S. ADVERTISING EXPENDITURES

($ million)

Year	Newspaper	Magazine	Television	Radio	Direct mail	Total[1]
1989e	n.a.	n.a.	n.a.	n.a.	n.a.	$125,000
1988	$31,197	$6,072	$25,686	$7,798	$21,115	118,050
1987	29,412	5,607	23,904	7,206	19,111	109,650
1986	26,990	5,317	22,585	6,949	17,145	102,000
1985	25,170	5,155	20,770	6,490	15,500	95,000
1984	23,715	4,850	18,585	6,025	13,480	—
1983	20,582	4,233	16,136	5,210	11,795	—
1982	17,694	3,710	14,329	4,670	10,319	—
1981	16,528	3,533	12,650	4,230	8,944	—
1980	14,794	3,149	11,366	3,702	7,596	54,000
1979	13,863	2,932	10,154	3,310	6,653	—
1978	12,214	2,597	8,955	3,052	5,987	—
1977	10,751	2,162	7,612	2,634	5,164	—
1976	9,618	1,789	6,721	2,330	4,786	—
1975	8,234	1,465	5,263	1,980	4,124	28,000
1970	5,704	1,292	3,596	1,308	2,766	20,000
1965	4,426	1,161	2,515	917	2,324	15,000

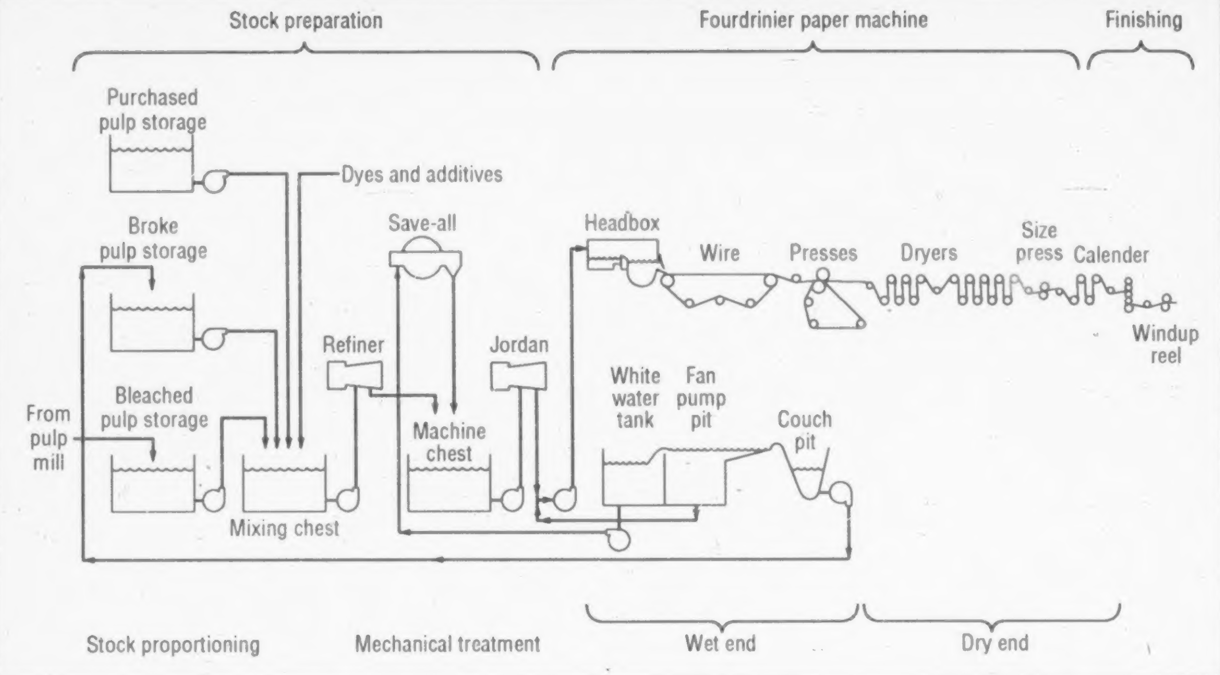
e = Estimate.

n.a. = Not available.

1. Includes other expenditures.

Source: Prepared for *Advertising Age* by Robert J. Coen, McCann-Erickson.

TYPICAL FLOW DIAGRAM FOR A FINE PAPER MILL


Stock preparation
Fourdrinier paper machine
Finishing
Purchased pulp storage
Dyes and additives
Broke pulp storage
Save-all
Headbox
Wire
Presses
Dryers
Size press
Calender
Windup reel
Refiner
Jordan
White water tank
Fan pump pit
Couch pit
From pulp mill
Bleached pulp storage
Machine chest
Mixing chest
Stock proportioning
Mechanical treatment
Wet end
Dry end

MARKET INDICATORS, PRINTING AND PUBLISHING PAPERS: VALUE OF SHIPMENTS

(million $ current)[1,2]

Year	Newspapers SIC: 2711	Periodicals SIC: 2721	Book publishing SIC: 2731	Book printing SIC: 2732	Commercial printing SIC: 2751, 2752, 2754	Manifold business forms SIC: 2761
1988e	$33,430	$18,046	$12,775	$3,700	$45,735	$8,298
1987e	31,532	16,758	11,675	3,385	41,350	7,592
1986	29,091	15,719	10,732	3,102	37,358	6,985
1985	27,015	15,246	10,196	2,919	35,559	6,669
1984	25,302	14,053	9,459	2,828	33,114	6,297
1983	24,050	12,943	8,475	2,600	28,785	5,195
1982	21,286	11,525	7,723	2,392	27,091	5,034
1981	20,050	9,843	6,760	2,556	23,149	4,735
1980	17,750	9,229	6,675	2,325	19,700	4,308
1979	16,125	8,240	6,040	2,100	18,200	3,846
1978	14,500	7,292	5,495	1,920	16,500	3,259
1977	12,966	6,077	4,882	1,696	14,800	2,884
1976	11,659	5,044	3,968	1,328	13,355	2,328
1975	10,433	4,380	3,537	1,241	11,691	2,185
1970	6,967	3,096	2,434	800e	7,865	1,233

e = Estimate.
1. Value for industry, including service.
2. Other printing categories, such as engraving and plate printing, greeting card publishing, blankbooks and looseleaf binders, bookbinding work, typesetting, photoengraving, electrotyping, and platemaking services are not included but amounted to almost $7.2 billion in 1987.
Source: U.S. Dept. of Commerce: "U.S. Industrial Outlook 1989."

Paper:

NEWSPRINT

Newsprint is used primarily by newspaper publishers, with much of the remainder going to commercial printers for preprinted newspaper inserts and government printing jobs. The furnish is mostly mechanical pulp, with chemical pulp added to improve runability on paper machines and printing presses.

Most newsprint is now produced on twin-wire units, replacing the traditional fourdrinier. More than 70% of North American capacity is equipped with twin-wires. These are either new machines or existing fourdriniers that have been rebuilt with twin-wires (such as the Bel-Baie, Symformer, Verti Forma, Papriformer, Periformer, or Duoformer). One way to modify a fourdrinier is through the addition of a top-former, which can be installed in as little as two days.

STATISTICS FOR NEWSPRINT

	1989e	1988	1987	1986
U.S.				
Production,				
000 short tons	5,998	5,982	5,842	5,630
Capacity, 000 tons	6,269	6,116	6,006	5,804
Utilization rate, %	95.1	97.8	97.3	97.0
Apparent U.S. consumption				
000 tons	14,098	14,357	14,547	13,825
lb/capita	113.6	116.8	119.5	114.8
000 tons/$ billion real GNP	3.12	3.24	3.41	3.35
CANADA				
Production,				
000 short tons	10,809	10,989	10,658	10,238
Capacity, 000 tons	11,381	11,117	10,940	10,896
Utilization rate, %	95.0	98.8	97.4	94.0

e = Estimate.

Source: *Pulp & Paper.*

The first commercial gap-formers to be used in newsprint production were installed in the late 1960s. These were the Vertiformer I and the Bel Baie I (considered the first blade formers) and the Papriformer (considered the first roll former). In the early 1970s, hybrids of the original gap-formers, namely the Symformer and the Duoformer F, became available from European machine manufacturers.

A third generation of twin-wire forming now being built into new machines represents a quantum leap in this technology. It will allow newsprint in the '90s to be made on machines trimming at least 300 in. (7.6 m) and operating at speeds well above 3,281 fpm (1,000 mpm). In fact, machine speeds are expected to reach 5,900 fpm (1,800 mpm) by the year 2000, according to Nystrom, Lee, Kobayashi (NKL) Inc.

At the same time, newsprint quality targets will soon surpass the capabilities of slower twin-wire machines unless methods unrelated to the wet end of the paper machine are implemented (e.g., use of fillers, soft calendering).

Newsprint produced on twin-wire machines has better sheet characteristics and less two-sidedness. Twin-wires also enhance productivity, as marginal speedup often results from faster drainage on machines that have this constraint. In 1982, the startup of *USA Today*, a Gannett daily national newspaper, fostered the use of twin-wire newsprint, which enables publishers to make better use of four-color printing.

Newsprint in the U.S. usually comes in a standard basis weight of 30 lb/3,000 ft^2, or 48.8 g/m^2. In the past two years, even Champion International Corp.'s Texas mills have gone to the new standard from 28.5 lb (46.4 g/m^2). Great Northern Nekoosa Corp.'s benchmark is still 28 lb (45.6 g/m^2), and goes as low as 26.5 lb (43.1 g/m^2). Newsprint is available in standard basis weights as low as 24 lb (39.5 g/m^2) and as high as 35 lb (56.9 g/m^2). Prior to 1974, the standard basis weight was 32 lb (52.1 g/m^2), but it was reduced to trim costs and conserve fiber.

Because three major printing methods are used by consumers of newsprint, paper manufacturers vary sheet surface qualities, including basis weight, opacity, and brightness. However, the choice of printing methods is narrowing to two—offset and flexographic—because printing quality standards have outpaced the abilities of letterpress to compete with those methods.

In 1970, letterpress accounted for virtually all newspaper printing. By 1988, offset-printed newspapers represented 58% of total U.S. daily circulation, according to the American Newspaper Publishers Assn. (ANPA). Letterpress accounted for 31%, and combined methods were used for 11%. Data from MAN Roland Inc., a printing press manufacturer, show that of all presses installed at U.S. daily newspapers by 1989, approximately 61% were offset, 33% were letterpress, and 6% were flexographic.

ANPA reported in 1989 that orders for offset presses were running 2:1 ahead of flexo unit orders, but further development of flexographic technology could turn that figure around. Offset quality is better than flexo; however, flexo has significant cost advantages and uses water-based inks that do not rub off. Newsprint must be highly water-resistant and lint-free in order to be used on flexo presses.

Most newsprint is not sized, apart from the addition of alum at the grinders to prevent resin buildup. Fillers are generally needed, due to the high opacity of groundwood pulp. Bleaching is done with peroxides or hydrosulfites, giving a final brightness of about 55 or 60, in contrast to the 60-to-65-brightness range preferred for higher grades of uncoated groundwood paper, such as directory.

Although the furnish used for newsprint is still primarily groundwood, thermomechanical (TMP) and chemi-thermomechanical (CTMP) pulps have become more commonplace. In many mills, TMP is used to replace some chemical pulp, which typically supplies 10% to 15% of newsprint furnish. With its longer fibers, chemical pulp makes a stronger sheet. Unbleached softwood sulfite pulps are used more commonly in Canada than in the U.S., where semibleached sulfate softwood pulp is preferred. TMP is weaker than chemical pulp but stronger than groundwood, and it costs less than chemical pulp. Secondary fiber also is used in some newsprint furnishes.

Approximately 12%—or two million metric tpy—of total North American newsprint capacity in 1988 used wastepaper as a raw material. Waste newspapers are deinked and added to other types of pulp or used alone. Garden State Paper Co. was the pioneer in this field. The company's flagship mill is in Garfield, N.J., and GSP's parent, Media

GROWTH OF NORTH AMERICAN CAPACITY BY AREA

(000 metric tons)

U.S.

Year	Northwest/ Midwest	South	West	Total
1991p	699	3,781	1,975	6,455
1990p	703	3,607	1,930	6,240
1989p	696	3,261	1,758	5,715
1988	692	3,125	1,733	5,550
1987	654	3,084	1,712	5,450
1986	648	2,967	1,700	5,315
1985	650	2,958	1,692	5,300
1984	594	3,051	1,660	5,305
1983	576	2,978	1,681	5,235
1982	584	2,940	1,606	5,130
1981	592	2,918	1,440	4,950
1980	633	2,627	1,160	4,420
1979	609	2,205	996	3,810
1978	670	2,080	960	3,710

CANADA

Year	Quebec	Ontario/ Manitoba	British Columbia	Atlantic	Total
1992p	5,206	2,581	2,166	1,862	11,815
1991p	5,122	2,470	2,094	1,864	11,550
1990p	4,968	2,234	1,913	1,860	10,975
1989p	4,715	2,092	1,766	1,752	10,325
1988	4,677	2,066	1,631	1,711	10,085
1987	4,567	2,076	1,608	1,674	9,925
1986	4,475	2,060	1,595	1,755	9,885
1985	4,500	2,040	1,630	1,650	9,820
1984	4,415	2,090	1,710	1,605	9,820
1983	4,535	2,045	1,770	1,620	9,970
1982	4,580	1,980	1,710	1,665	9,935
1981	4,495	1,985	1,440	1,570	9,490
1980	4,308	1,985	1,352	1,485	9,130
1979	4,251	1,972	1,395	1,445	9,063
1978	4,263	1,920	1,370	1,429	8,982

p = Preliminary.

Source: Canadian Pulp & Paper Assn., *Newsprint Data*.

General Inc., has interests in two other recycled newsprint mills in Dubin, Ga., (Southeast Paper Manufacturing Co.) and San Luis Potosi, Mexico. In addition, its patented process is licensed to Golden State Paper Co. and FSC Paper Co.

Recycled newsprint mills use furnish that consists of up to 100% deinked newspapers, which tend to be plentiful in the urban areas where mills are located. Some mills also use coated magazine stock for up to 15% of their fiber. In cases where the furnish is not totally wastepaper-based, deinked newsprint is combined with groundwood mechanical pulp or TMP. The mix varies widely according to fiber availability and the mill's specific cost structure.

The quality of recycled newsprint has improved steadily with better technology, making it comparable to or better than virgin sheets in some pressrooms. Southeast Paper claims it makes a sheet that meets the high four-color printing standards of *USA Today*. Gannett began experimenting with the use of recycled newsprint for *USA Today* in 1988, probably compelled to do so by the increasing political pressure placed on publishing companies to use recycled newsprint.

Kenaf—a fast-growing, nonwood fibrous plant—also is being studied as a fiber source for newsprint. Extensive studies have been done on newsprint made from kenaf by the ANPA and U.S. Dept. of Agriculture. The efforts were subsequently taken up by Kenaf International and Canadian Pacific Forest Products Ltd. KI includes the *Bakersfield Californian*, Agrifuture Inc., Bechtel Corp., Sequa Corp. and Werdell Ventures.

KI originally planned to construct a 215,000-tpy mill near McAllen, Texas, by 1991, but it later delayed the project indefinitely, indicating that it would move forward when newsprint market conditions improved.

In the summer of 1987, CPFP produced about 85 short tons of newsprint from kenaf pulp at its Trois Rivières, Que., mill. The newsprint was tested at several southwestern newspapers, and was considered to be stronger and whiter, requiring less ink and yielding brighter colors than regular newsprint. Because it contains no lignin, the paper will not yellow. Other advantages are lower production costs and less pollution.

INDUSTRY STRUCTURE

Canada and the U.S. together produce approximately half the world's supply of newsprint. Canada produces more than 30%, while the U.S. produces over 17%. No oth-

NORTH AMERICAN RECYCLED NEWSPRINT PRODUCERS

Company	Mill	Capacity (metric tpy)	Recycled content
U.S.			
FSC Paper	Alsip, Ill.	121,500	100%
Garden State	Garfield, N.J.	199,500	100
Golden State	Pomona, Calif.	122,500	100
Manistique	Manistique, Mich.	56,000	100
North Pacific	Longview, Wash.	704,000[1]	25[2]
Smurfit	Newberg, Ore.	350,000	50
	Oregon City, Ore.	217,000	50
Southeast	Dublin, Ga.	415,000[3]	100
Stone Container	Snowflake, Ariz.	264,100	50
CANADA			
Atlantic Packaging	Whitby, Ont.	136,100[4]	100
Quebec & Ontario	Thorold, Ont.	310,000	50

1. Includes new 230,000-tpy machine starting up in late 1991.
2. Estimated net recycled content among mill's three paper machines.
3. Includes new 215,000-tpy machine started September 1989.
4. New 136,100-tpy machine starting up mid-1990.

Sources: Newsprint Information Committee, *Pulp & Paper Week*.

U.S. NEWSPRINT CAPACITY AND PRODUCTION

(000 short tons)

Year	Capacity	Production	Operating rate
30-lb weight			
1991p	7,117	—	—
1990p	6,877	—	—
1989p	6,301	—	—
1988p	6,116	5,969	98%
1987	6,006	5,842	97
1986	5,804	5,630	97
1985	5,788	5,428	94
1984	5,851	5,539	95
1983	5,774	5,167	89
1982	5,654	5,042	89
1981	5,457	5,239	96
1980	4,836	4,672	97
1979	4,199	4,062	97
1978	4,104	3,768	92
1977	4,069	3,871	95
1976	4,014	3,736	93
1975	3,848	3,691	96
1974	3,722	3,561	96
32-lb weight			
1974*	3,889	3,690	95
1973	3,819	3,738	98
1972	3,694	3,656	99
1971	3,642	3,476	95
1970	3,533	3,464	98
1969	3,374	3,362	100
1968	3,176	3,045	96
1967	2,844	2,709	95
1966	2,545	2,483	98
1965	2,372	2,245	95

p = Preliminary.
* Adjusted to 32-lb equivalent basis weight.

Sources: Canadian Pulp & Paper Assn. and American Paper Institute.

er nation produces more than 10%. The U.S. is the world's leading consumer of newsprint, using more than 36% of global supplies. The nearest rival is Japan, which consumes just under 10%.

Canada is the world's leading producer and exporter of newsprint. It consumes only about 12% of its own production; the remainder accounts for nearly 60% of global exports. Canada's leading customer is the U.S., which received 82% of the newsprint exported from Canada in 1988. Canadian newsprint represented about 57% of U.S. consumption that year.

The U.S. newsprint industry contributed almost 41% of total domestic consumption in 1988, compared with 34% in 1978. At the same time, Canadian exports to the U.S. dropped to 57% in 1988 from 66% in 1978. U.S. newsprint imports from countries other than Canada advanced rapidly to 352,900 metric tons in 1987 from 67,000 tons in 1983. However, they dropped to 274,800 tons in 1988, mainly because of currency exchange rates that made imports less competitive in the U.S.

Canada has the bulk of North American newsprint capacity, accounting for about 65% of the 15.4 million metric tons manufactured in 1988. However, the U.S. has experienced the greatest growth in capacity during the past decade. Between 1979 and 1989, U.S. capacity increased 50%, while Canadian capacity rose by only 11.2%.

Capacity increases in both countries slowed considerably in the mid-1980s to allow demand to catch up with expansion that came earlier in the decade. More older machines, particularly in Canada, have been shut down or converted to higher-value groundwood specialties in recent years.

The North American newsprint market is headed for yet another round of rapid expansion. Between 1989 and 1991, 12 new newsprint machines with 2.5 million metric tons of annual capacity will come online. Canadian newsprint capacity will move up 11.3% (1,120,000 metric tons) between 1987 and 1990, while U.S. capacity will grow by 14.5% (790,000 tons), according to Canadian Pulp & Paper Assn. and American Paper Institute surveys. This will bring Canadian newsprint capacity to 10.975 million tons and U.S. capacity to 6.240 million tons in 1990.

Major Canadian projects include new machines at Thunder Bay, Ont. (CPFP); Mackenzie, B.C. (Finlay Forest Industries Ltd.); and Trois Rivières, Que. (Kruger Inc.) In addition, greenfield mills are planned at Whitecourt, Alta. (Alberta Newsprint Co.); Whitby, Ont. (Atlantic Packaging Products Ltd.); Gold River, B.C. (Gold River Newsprint Ltd.); and Port Mellon, B.C. (Howe Sound Pulp & Paper Co.)

In the U.S., new machines are planned through 1991 at the following locations: Grenada, Miss. (Newsprint South Inc., a subsidiary of Mississippi Chemical cooperative); Dublin, Ga. (Southeast Paper); Usk, Wash. (Ponderay Newsprint Co., a partnership of CPFP and five publishers); Claiborne, Ala. (Alabama River Newsprint Co., a partnership of Abitibi-Price Inc. and Parsons & Whittemore Inc.); and Longview, Wash. (North Pacific Paper Co.)

In addition, recycled newsprint machines for sites in the northeastern U.S. are under study by GSP, Smurfit Newsprint Co., and Steinbeis Group of Fed. Rep. Germany. Other companies considering newsprint machines—not necessarily recycled—sometime in the early 1990s include Bear

U.S. CONSUMPTION OF NEWSPRINT

(000 short tons)

Year	Consumption	Shipments from U.S.	Shipments from Canada	Shipments from Others	Consumer stocks[1]
30-lb weight					
1988	13,599	5,548	7,812	303	1,619
1987	13,584	5,540	7,812	389	1,555
1986	13,158	5,266	7,424	330	1,398
1985	12,772	5,123	7,357	366	1,537
1984	12,600	5,299	7,260	208	1,465
1983	11,672	4,860	6,651	74	1,300
1982	11,142	4,686	6,168	46	1,387
1981	11,204	4,907	6,682	41	1,628
1980	11,120	4,473	6,744	138	1,202
1979	11,240	3,970	7,023	146	967
1978	10,872	3,674	7,102	0	1,070
1977	10,232	3,737	6,341	0	1,181
1976	9,611	3,632	6,251	57	1,333
1975	9,254	3,566	5,489	33	1,004
1974	10,284	3,457	6,949	213	1,170
32-lb weight					
1974*	10,685	3,582	7,239	213	1,248
1973	10,794	3,657	6,855	381	782
1972	10,547	3,549	6,430	328	784
1971	9,835	3,307	6,146	317	1,041
1970	9,706	3,316	6,163	314	1,110
1969	9,855	3,246	6,431	293	1,017
1968	9,327	2,944	6,107	284	894
1967	9,238	2,612	6,263	283	885

1. Based on data from American Newspaper Publishers Assn.
* Adjusted to 32-lb equivalent basis weight.

Source: Canadian Pulp & Paper Assn.

Island Paper Co., Ashland, Va.; Donohue Inc., Amos, Que.; Normick/Forex, Val d'Or, Que.; Westbrook Wood Products, Medford, Ore.; Daishowa America Co. Ltd., Port Angeles, Wash.; Stora Forest Products Ltd., Port Hawkesbury, N.S.; and Cascades Inc., Port Cartier, Que.

Observers once thought that because of the high cost of new mills and the dwindling supply of untapped forestland, Canadian capacity would be expanded incrementally or by adding machines at existing mills. This changed, though, as profits soared during the sellers' market of 1986-88, giving mills substantial cash to reinvest. On top of this, the increased pressure to use recycled fiber led virtually all producers to take a closer look at installing deinking facilities.

Recycling. Mounting concern about solid waste in major North American cities, particularly in the U.S., has inspired lawmakers to draft bills to expand markets for recycled newsprint, the logic being that more old newspapers will be diverted from the solid waste stream and into deinking plants.

Since Florida passed the first mandatory recycled newsprint usage bill in late 1988, many other states have proposed or adopted similar bills. By late 1989, California and Connecticut had passed laws requiring publishers to consume a certain portion of recycled newsprint, and Wisconsin was close to adopting its own version of those laws. Whether or not any of these states' goals can be met within the time frames mandated is questionable.

Although virtually every newsprint producer in North America has begun to consider adding or expanding recycled newsprint capacity to meet the legislated boost in demand, some of them question whether it is feasible in the long term. A deinking plant and related modifications to papermaking equipment can cost $60 million or more. Too much deinking capacity could lead to a shortage of recycled fiber. And there is disagreement over how much secondary fiber can be reclaimed, as various factors such as contamination, improper handling, and lack of consumer interest tend to limit availability.

CANADIAN CAPACITY, PRODUCTION, AND SHIPMENTS OF NEWSPRINT

(000 short tons)

Year	Capacity[1]	Production	Operating rate (%)	Change in capacity	Change in production	Shipments
30-lb weight						
1989e	11,381	—	—	—	—	—
1988e	11,117	10,989	99%	176	331	10,876
1987	10,940	10,658	98	44	420	10,755
1986	10,896	10,238	94	72	331	10,254
1985	10,825	9,907	92	0	-28	9,916
1984	10,825	9,935	92	-165	581	9,941
1983	10,990	9,354	85	39	416	9,302
1982	10,951	8,939	82	540	-922	8,899
1981	10,411	9,861	94	347	354	9,829
1980	10,064	9,507	94	77	-144	9,504
1979	9,987	9,651	97	126	-62	9,677
1978	9,861	9,713	98	-41	725	9,792
1977	9,902	8,988	91	-19	73	9,005
1976	9,921	8,915	90	29	1,218	8,712
1975	9,892	7,697	78	-146	-1,851	7,728
1974	10,038	9,548	95	—	—	9,597
32-lb weight						
1974[2]	10,474	9,946	95%	137	806	9,998
1973	10,337	9,140	88	37	320	9,199
1972	10,300	8,820	86	60	365	8,901
1971	10,240	8,455	83	395	-264	8,362
1970	9,845	8,719	89	170	-99	8,704
1969	9,675	8,818	91	20	787	8,797
1968	9,655	8,031	83	361	-20	8,096
1967	9,294	8,051	87	416	-368	7,968
1966	8,878	8,419	95	457	699	8,385
1965	8,421	7,720	92	147	419	7,747

e = Estimate.

1. Tonnage data for 1965-74 are based on 32-lb weight newsprint; those for 1974-77 are measured in terms of 30-lb basis weight.

2. Adjusted to 32-lb equivalent basis weight.

Source: Canadian Pulp & Paper Assn.

Approximately two million metric tons of North American newsprint capacity contained some percentage of recycled fiber in 1989. Canada's portion of that was 16% (310,000 tons). Canadian mills will find it much less attractive to invest in deinking facilities, as the cost of getting old newspapers to remote mill sites may be prohibitive.

A task force with members from API, CPPA, and ANPA was formed in 1989 to follow recycling issues. Several more states are expected to adopt some form of recycled newsprint legislation in 1990.

Tonda Rush, director of newspaper projects and plans for ANPA, said late in 1989 that the industry could expect "at the very least, another 18 to 24 months of activity in this area before the legislatures and the markets begin to settle down." Among the states expected to take action in 1990 are Maine, Ohio, Virginia, Illinois, Michigan, and Washington, D.C. (Wisconsin was expected to act in late 1989.) The approach to recycling varies from state to state, but all bills are aimed at reducing waste and curbing garbage buildup problems. Consumers and suppliers of newsprint will be challenged in keeping up with the requirements.

Florida, the pacesetter with these bills, has imposed on state publishers a minor tax of 10¢ for every ton of virgin newsprint used exceeding half of total consumption. The tax would rise to 50¢/ton by 1992 if certain goals are not reached.

California included supercalendered (SC) and machine-finished (MF) uncoated groundwood grades along with newsprint in its mandatory consumption bill. A fine of $1,000 will be imposed for not meeting goals that top off at 50% of total consumption by the year 2000. Meanwhile, Wisconsin proposed a law late in 1989 focusing on the total amount of recycled fiber consumed as a proportion of total newsprint used statewide.

Upgrading capacity. Machine makeup in the newsprint industry changed considerably during the 1980s. Older, smaller machines were shut down and dismantled or converted to the production of groundwood specialties. Larger and faster newsprint units capable of producing higher-quality newsprint replaced these smaller, less effi-

U.S. RECYCLED NEWSPRINT LEGISLATION, BY STATE*

State	Bill	Recycled content	Taxes	Penalties	Mandatory usage[1]		Status
					Goal	Timetable	
California	A.B. 1305	40%		Not more than $1,000 per violation	25% 50%	1/1/91 1/1/2000	Passed
Connecticut	H.B. 6641	40%			20% 90%	1993 1998	Passed
Florida	S.B. 1192		10¢/ton until 10/92; 50¢/ton if goal not reached		50%	1992	Passed
Illinois	H.B. 2458	50%	10¢/ton	Not more than $5,000 per violation	10% 50%	1992 1998	Pending
Louisiana	Draft		10¢/ton				Failed
Massachusetts	H.B. 5654	90%	$56/ton credit on recycled newsprint				Pending
Nebraska	L. 163		$1/ton				Failed
New Jersey	A.B. 4809	50%			45% 90%	1990 1992	Pending
	A.B. 4703	40%			45% 90%	1989 1991	Pending
New York	S.B. 4504	10%		Papers not meeting requirement not to be sold in state		1991	Pending
North Carolina	H.B. 1225		10¢/ton				Failed
Oregon	H.B. 3218		$1/ton				Failed
Rhode Island	H.B. 7596		$11/ton by 1991 $56/ton by 1994				Pending
Virginia	Draft		10¢/ton				Failed
Wisconsin	S.B. 300			$500 maximum for not reporting	10% 45%	1991[2] 2001	Pending

* Does not include preference purchasing provisions for state agencies. Includes states where legislation is most advanced.

[1] Applies to amount of total consumption that must be recycled-fiber based. Ranges imply goals to be phased in between these dates.

[2] Goals are aggregate of statewide recycled fiber consumed in proportion to total newsprint used.

Source: American Newspaper Publishers Assn.

cient machines.

Between 1982 and 1991, the Canadian industry will have idled 25 newsprint machines with a total capacity of 1.185 metric tons, according to Jim Rowland, editor of *Canadian Paper Analyst*. Closely associated with this trend are the conversions of newsprint machines to groundwood specialties, involving another 1.032 million tons. At the same time, 16 new newsprint machines with an estimated total capacity of 3.220 million tons will have been built (not including NorPac's new 230,000-tpy machine at Longview, Wash., announced in late 1989).

Three world-scale newsprint machines in Canada and two in the U.S. were slated to come online during 1989, adding 1.045 million tons to North American newsprint capacity. However, three Canadian newsprint machines were shut down indefinitely during 1989—a loss of 155,000 tpy of capacity. More shutdowns were expected as the market downturn makes marginal machines unprofitable.

Added to these shutdowns were machine conversions. Abitibi-Price upgraded about 100,000 tpy of newsprint capacity to groundwood paper production at its Alma and Kenogami, Que., mills. Fletcher Challenge installed soft calendering at its Elk Falls, B.C., mill to take advantage of demand from the insert market. (See Uncoated Groundwood chapter.)

So closely associated are groundwood specialties and newsprint that it is hard to determine capacity accurately. Some of their end uses are similar, grade descriptions are often applicable to both, and certain paper machines can make a range of groundwood-based papers.

Stone-Consolidated Ltd., for example, is building a new 180,000-tpy machine at its Grand'Mère, Que., mill to make grades ranging from standard rotogravure to sc papers. Other mills are considering a grade known as "improved newsprint," which meets *USA Today* standards. Commodity newsprint may itself be broken into at least three quality levels as technology advances and as competition intensifies over the next few years.

In soft newsprint markets, several producers dedicate standard newsprint machines to making MF grades, which usually involves running standard newsprint through more calender nips during the manufacturing process.

Likewise, end users tend to jump around in this type of market. Most noteworthy in 1988-89 was Sears, with its "every-day-low-prices" promotional campaign. *USA Weekend* switched to newsprint from groundwood specialties, and *Parade* was also considering downgrading to newsprint.

Three options are possible when upgrading newsprint machines to groundwood specialties: change in basis weight, increase in brightness, or improvement in finish, according to Jaako Pöyry International Oy. A cleaner, lower-freeness mechanical pulp is required to lower basis weight, and chemical pulp content must be increased to boost strength. A change in the bleaching process is often necessary as well.

Hydrosulfite bleaching is adequate with some fiber, but southern pine may require switching to peroxide bleaching, which results in higher capital and operating cost[illegible] With borderline-quality woo[illegible] it may be possible to sort o[illegible] the better wood for groundwood specialties production and to reserve the lower-quality wood for chemical pulp or newsprint production. The groundwood machine's stock and whitewater systems may also require separation from the rest of the mill to retain brightness.

If mill officials choose to upgrade the finish by adding a

NEW NORTH AMERICAN NEWSPRINT MACHINES SINCE 1980

Company	Location	Capacity (000 short tpy)	Startup
Bear Island Paper	Ashland, Va.	175	1980
Boise Southern	DeRidder, La.	192	1980
MacMillan Bloedel	Powell River, B.C.	176	1981
Smurfit Newsprint	Newberg, Ore.	210*	1981
North Pacific Paper	Longview, Wash.	210	1981
Fletcher Challenge	Crofton, B.C.	193	1982
Fletcher Challenge	Campbell River, B.C.	193	1982
Donohue-Normick	Amos, Que.	175	1982
Quebec & Ontario Paper	Thorold, Ont.	171*	1982
Quebec & Ontario Paper	Thorold, Ont.	171*	1982
Abitibi-Price	Iroquois Falls, Ont.	209	1983
Abitibi/Augusta Newsprint	Augusta, Ga.	226	1983
Canadian Pacific Forest Products	Gatineau, Que.	175	1987
Donohue	Clermont, Que.	198	1987
Fletcher Challenge	Mackenzie, B.C.	198	1989
Gold River Newsprint	Gold River, B.C.	254	1989
Newsprint South	Grenada, Miss.	224	1989
Southeast Paper	Dublin, Ga.	237*	1989
Ponderay Newsprint	Usk, Wash.	231	1989
Atlantic Packaging	Whitby, Ont.	150*	1990
Kruger	Trois Rivières, Que.	198	1990
Alabama River	Claiborne, Ala.	243	1990
Canadian Pacific Forest Products	Thunder Bay, Ont.	265	1990
Alberta Newsprint	Whitecourt, Alta.	243	1990
Howe Sound Pulp & Paper	Port Mellon, B.C.	220	1991
North Pacific Paper	Longview, Wash.	253*	1991

* Recycled newsprint machines.

Sources: *Pulp & Paper Project Report*, *Pulp & Paper Week*.

MAJOR CHANGES IN NORTH AMERICAN NEWSPRINT CAPACITY, 1989-92

Company	Mill	Capacity (000 metric tpy)	Startup
Announced			
Abitibi-Price	Alma, Que.	(60)[1]	1989
Bowater Mersey	Brooklyn, N.S.	50	1989
Finlay Forest[2]	Mackenzie, B.C.	180*	1989
Gold River[3]	Gold River, B.C.	230*	1989
Newsprint South[4]	Grenada, Miss.	203*	1989
Southeast Paper Mfg.	Dublin, Ga.	215*[5]	1989
Ponderay Newsprint[6]	Usk, Wash.	210*	1989
Kruger	Trois Rivières, Que.	180*[7]	1990
Stone-Consolidated[8]	Grand'Mère, Que.	(70)[9]	1990
Alabama River[10]	Claiborne, Ala.	220*	1990
Atlantic Packaging	Whitby, Ont.	136*[5]	1990
Alberta Newsprint[11]	Whitecourt, Alta.	220*	1990
Canadian Pacific Forest Products[12]	Thunder Bay, Ont.	60 (net)*[13]	1991
Howe Sound Pulp & Paper[14]	Port Mellon, B.C.	200*	1991
North Pacific Paper	Longview, Wash.	230*[5]	1991
Proposed			
Garden State Paper	Northeast U.S.	n.a*[5]	n.a.
Smurfit Newsprint	Northeast U.S.	255*[5]	n.a.
Steinbeis Group	East U.S. or Canada	n.a*[5]	n.a.
Bear Island	Ashland, Va.	200*	n.a.
Donohue	Amos, Que.	200*	n.a.
Smurfit Newsprint	Newberg, Ore.	275*[5]	n.a.
Westbrook Wood Products	Medford, Ore.	n.a*[15]	n.a.
Daishowa America	Port Angeles, Wash.	200*	1992e
Cascades	Port Cartier, Que.	225*[15]	n.a.
CPFP/Kenaf International	McAllen, Texas	215*[16]	n.a.

* New newsprint machines.
e = Estimate.
n.a. = Not available.

1. Conversion to directory paper.
2. Subsidiary of Fletcher Challenge Canada Ltd.
3. New company consisting of major shareholder Canadian Pacific Forest Products Ltd. (CPFP) and seven partners.
4. Owned by Mississippi Chemical Co.
5. Recycled newsprint.
6. Partnership between CPFP and five publishers.
7. Company-wide newsprint capacity increase will be lower due to conversion of 70,000-tpy newsprint machine at Corner Brook, Nfld., to supercalendered paper.
8. Formerly Consolidated-Bathurst Ltd. Acquired by Stone Container Corp. in 1989.
9. Nos. 8 and 9 newsprint machines to be shut down when groundwood papers machine starts up in mid-1990.
10. Fifty-fifty joint venture of Abitibi-Price Inc. and Parsons & Whittemore Inc.
11. Investor group headed by Vancouver, B.C., businessman Ronald Stern in partnership with unidentified private Canadian companies.
12. Formerly Great Lakes Forest Products Ltd., which was merged with CIP Inc. under CPFP.
13. New 240,000-tpy unit replaces two older machines.
14. Partnership of Canfor Corp. and Oji Paper Co. Ltd.
15. May also be partially or fully groundwood specialties.
16. Based on kenaf fiber.

Source: *Pulp & Paper Week.*

ESTIMATED ANNUAL NEWSPRINT CAPACITY OF MAJOR COMPANIES

(000 metric tons)

Company	Canada	U.S.	Total	Capacity share (%)
Abitibi-Price	1,630	349	1,979	12.4%
Canadian Pacific Forest Products[1]	1,530	20	1,550	9.7
Bowater[2]	224	943	1,167	7.3
Fletcher Challenge[3]	1,118	—	1,118	7.0
Stone-Consolidated	953	—	953	6.0
Kruger	790	—	790	4.9
Champion International	—	778	778	4.9
Quebec & Ontario Paper	761	—	761	4.8
Boise Cascade	227	523	750	4.7
Kimberly-Clark[4]	343	380	723	4.5
MacMillan Bloedel	622	—	622	3.9
Smurfit Newsprint	—	567	567	3.5
Donohue	524	—	524	3.3
North Pacific Paper	—	474	474	3.0
Daishowa Forest Products	452	—	452	2.8
Rothesay Paper	320	—	320	2.0
Great Northern Paper	—	318	318	2.0
Domtar	269	—	269	1.7
Stone Container[5]	—	264	264	1.6
Southeast Paper Mfg[6]	—	212	212	1.3
Bear Island Paper	—	203	203	1.3
Garden State Paper[7]	—	197	197	1.2
James Maclaren Industries	187	—	187	1.2
F.F. Soucy	170	—	170	1.1
Stora Forest Industries	170	—	170	1.1
Golden State[8]	—	122	121	0.8
Inland Empire Paper	—	66	66	0.4
Newsprint South[9]	—	60	56	0.3
Manistique Papers	—	56	56	0.3
James River	—	30	30	0.2
St. Raymond Paper[10]	33	—	33	0.2

Total North American capacity (1989): 16.012 million tons*
Capacity of top five producers: 42.3%
Capacity of top ten producers: 66.0%

* Preliminary figures from American Paper Institute and Canadian Pulp & Paper Assn.

[1] Created by merger of CIP Inc. (100% owned) and Great Lakes Forest Products Ltd. (54.3% owned) in 1988. Includes estimated 1989 output from Gold River Newsprint Limited Parternship and Ponderay Paper Co. (40% owned) mills.

[2] Includes Catawba Newsprint Co. (51.0% owned) and Bowater Mersey Paper Co. Ltd. (51.0% owned).

[3] Combined operations of Crown Forest Industries (100% owned) and British Columbia Forest Products Ltd. (69% owned) in 1988. Includes startup of new machine at Mackenzie, B.C., in March 1989.

[4] Includes Spruce Falls Power & Paper Co. Ltd. (50.5% owned).

[5] Includes Snowflake, Ariz., mill, but not former Consolidated-Bathurst Inc. mills.

[6] Includes estimated 1989 output from new 215,000-tpy newsprint machine started up in fall 1989.

[7] Does not include Pomona, Calif., mill, which was sold in 1988 to Barris Industries Inc. and Giant Group Ltd.

[8] Former Garden State Paper Co. mill (see footnote 7).

[9] Owned by Mississippi Chemical Co. Includes estimated 1989 output based on July 1989 startup.

[10] Declared bankruptcy in July 1989.

supercalender, the wood in the woodyard should be sorted to isolate fresher and whiter wood. Low-freeness pulp is also particularly important for sc paper, and careful screening is necessary. Most sc paper mills operate with two supercalenders, which may cause layout problems in an existing mill.

Troubled Canadian industry. A study of competitiveness in the newsprint industry among Canada, the U.S. West, the U.S. South, Sweden, Norway, and Finland was conducted by Price Waterhouse Associates for 1982-83. Canada had the highest manhours and labor costs per ton of output. Capacity of the average Canadian paper machine was the lowest at 97,000 metric tpy; Swedish machines averaged 148,000 tpy. The report also found that it takes Canadian mills six manhours to produce a ton of newsprint, while Swedish mills can do it in half the time.

Canada's ranking, however, improved in later years with variations in currency exchange rates relative to the Nordic countries. In a study commissioned by Canada's Forest Sector Advisory Council, Canada's ranking in 1987 moved from highest-cost to third-lowest-cost (after delivery) producer among all the same regions, except Norway, which was excluded due to insufficient data. Canada still had the lowest average annual capacity per machine at 100,000 metric tpy, compared with the high of 176,000 tpy in Finland. Canada also had the highest labor costs and lowest energy bill in 1987.

The Price Waterhouse report showed that obsolescence plagued the Canadian newsprint industry. It noted that the productivity advantages of the other regions was due to their much higher levels of investment. However, a study completed in early 1989 by Woodbridge, Reed & Associates (WRA) found that while Canada's newsprint sector appears to be uncompetitive in the global marketplace, it actually has the high-quality fiber and low-cost power that are necessary to achieve low unit operating costs and top-quality paper.

Increases in Canadian newsprint capacity will be based on TMP or CTMP technologies. Costs will decrease as use of kraft pulp is reduced to 2% to 8% of total fiber. A 100% TMP sheet is also possible. Older machines will be converted, and excess kraft pulp capacity will be integrated with higher-value printing/writing grades, according to WRA.

In 1988, approximately 137 newsprint and uncoated groundwood machines were located in North America, according to Morgan Stanley. Of these machines, 66 produced less than 60,000 metric tpy, and about 40 of them were located in Canada. World-scale newsprint machines average 220,000 tpy.

Canadian newsprint machines are generally older than those in the U.S. Some date back to the 1920s and 1930s, and most are at least three decades old. Despite speedups and rebuilds, these relatively inefficient machines often cannot compete with modern fourdrinier and twin-wire paper machines. U.S. mills also have the advantage in terms of fiber and transportation costs. However, finance costs at U.S. mills are higher.

The foreign exchange rate for Canadian currency is crucial to determining the competitiveness and profitability of the country's newsprint industry. For example, a 3% to 4% rise in the Canadian-U.S. dollar exchange rate in 1988

CANADIAN NEWSPRINT AND GROUNDWOOD SPECIALTIES CAPACITY CHANGES, 1982-91

(metric tons)

	Newsprint	Groundwood specialties
Capacity 1981	9,490,000	660,000
Machine closures (1982-91)		
1982 Abitibi-Price, Grand Falls, Nfld.	35,000 (1)*	—
Stone-Consolidated, Grand'Mère, Que.	15,000 (1)	—
Quebec & Ontario Paper, Thorold, Ont.	220,000 (5)	—
1983 Abitibi-Price, Iroquois Falls, Ont.	130,000 (4)	—
Abitibi-Price, Sault Ste. Marie, Ont.	—	20,000 (1)
Stone-Consolidated, Shawinigan, Que.	40,000 (1)	—
Stone-Consolidated, Grand'Mère, Que.	15,000 (1)	—
1984 Abitibi-Price, Iroquois Falls, Ont.	50,000 (1)	—
1985 MacMillan Bloedel, Powell River, B.C.	65,000 (1)	—
Maclaren, Buckingham, Que.	160,000 (2)	—
1986 Canadian Pacific, Gatineau, Que.	80,000 (1)	—
1987 Abitibi-Price, Kenogami, Que.	—	60,000 (2)
Donohue, Clermont, Que.	40,000 (1)	—
1989 Stone-Consolidated, Shawinigan, Que.	45,000 (1)	—
1990 Canadian Pacific Forest Products, Thunder Bay, Ont.	180,000 (2)	—
Stone-Consolidated, Grand'Mère, Que.	70,000 (2)	—
Donohue, Clermont, Que.	40,000 (1)	—
Total closures	1,185,000 (25)	80,000 (3)
Increases in capacity, 1982-91		
New machines	3,220,000 (16)	370,000 (3)
Conversions to groundwood specialties	—	1,032,000
Capacity 1991	11,525,000	1,982,000

* ( ) represents number of machines involved.

Source: *Canadian Paper Analyst.*

caused Canadian mills to lose nearly 40% of a $40/metric ton price increase implemented at the beginning of the year.

Canadian newsprint producers have gradually lost global market share, dropping from 35.0% to 29.7% during the 1978-88 period. In addition, Canada's share loss in its biggest market—the U.S.—is expected to worsen in the early 1990s as the industry's capacity grows. However, the loss may be somewhat offset by the numerous upgrades planned for Canadian mills through 1991 and beyond, which will give Canadian producers a cost advantage more even with U.S. producers.

Labor relations are another problem for the Canadian industry. Province-wide strikes in British Columbia and sporadic work stoppages in eastern Canada have made publishers wary of Canadian producers' long-term reliability. The Canadian Paperworkers Union represents most unionized workers throughout the country and traditionally bargains province-wide, as in British Columbia. Otherwise, it selects a target company with which to negotiate, and then applies a master agreement to subsequent negotiations, as in eastern Canada.

The pattern of labor negotiations in recent years seems to be changing. Strikes have been kept to a minimum as management and labor try harder to reconcile their differences. Canadian production losses caused by strikes were as high as 20% in 1975, but they dropped below 1% of capacity in 1985. In 1988, only 0.6% of Canadian newsprint capacity was lost as a result of strikes.

In the latest round of bargaining, strikes were averted entirely. In 1986, British Columbian mills bargained an agreement quickly and without incident. In 1987, eastern Canadian mills managed to sign a new contract only a few weeks after the expiration of the old agreement and without any work stoppages. Current contracts expire in 1990 in eastern Canada, and in 1991 in British Columbia.

Newsprint demand. Newsprint consumption in the U.S. totaled 12.337 million metric tons in 1988—a slight 0.1% increase from the previous year's all-time high, according to ANPA. The strongest regional demand growth was in the South, which accounted for 30.1% of total consumption by U.S. daily newspapers in 1988—up from 27.7% in 1975. Demand in the West rose to about 23.0% from 18.7% during the same period. Demand in the Northeast declined from 26.4% to 25.3%, while the Midwest turned in the worst performance, with consumption dropping from 27.2% to less than 21.0%.

Newsprint demand is best determined by the performance of the daily newspaper industry, because it is by far the chief consumer of newsprint, accounting for nearly 75% of total U.S. consumption in 1988. Advertising and circulation figures are watched closely to determine how much newsprint will be consumed in a given year.

Daily newspaper circulation has been on a fairly level trajectory since the early 1970s. It declined by 0.5% in 1985 and 0.4% in 1986, then rebounded by 0.5% in 1987 and 0.2% in 1988, according to ANPA. In contrast to daily sales, Sunday circulation has steadily gained ground. It increased an average of 1.5%/year between 1980 and 1985, then took off with a 4.6% boost in 1986 and another 6.6% increase in 1987. Sunday circulation rose a modest 0.2% in 1988.

Modest circulation growth combined with lineage gains have kept newsprint consumption healthy. Overall, U.S. newsprint consumption rose at an average rate of 2.8%/year between 1980 and 1986 to 11.937 million metric tons. In 1987, the gain in newsprint consumption measured 3.0% higher, and then flattened out in 1988. Excluding 1988, the consumption gains compared favorably with real GNP growth averaging 2.4%/year between 1980 and 1986.

Between 1974 and 1984, U.S. newsprint consumption rose at a 2.1% compound annual rate, while real GNP advanced 2.8%. During the early 1980s, newsprint consumption appeared to be moving ahead of growth in the economy. However, in 1987 it began to

NORTH AMERICAN NEWSPRINT INVENTORY TRENDS

(000 metric tons)

Year	Consumption (U.S.)	Year-end stocks held by all U.S. consumers	Days of supply held at year's end by U.S. consumers	Year-end stocks held by all mills in North America
1988	12,337	1,469	46	338
1987	12,323	1,411	45	225
1986	11,937	1,269	42	326
1985	11,587	1,394	46	346
1984	11,431	1,329	45	358
1983	10,589	1,179	42	402
1982	10,108	1,258	47	342
1981	10,164	1,477	56	232
1980	10,088	1,090	42	186
1979	10,199	877	34	178
1978	9,864	970	38	204
1977	9,281	1,070	43	287
1976	8,670	1,206	52	297
1975	8,325	903	44	105
1974	9,262	1,052	48	151
1973	9,741	753	32	197
1972	9,551	667	26	252
1971	8,922	885	38	338

Source: Canadian Pulp & Paper Assn.

trail GNP. By 1988, newsprint consumption was up a scant 0.1%, compared with a 4.6% rise in the economy.

Part of the problem with U.S. newsprint demand in 1988 is attributed to upheaval in the retail industry. Leveraged buyouts of R.H. Macy's, Federated Department Stores, and Allied Stores led to a cutback in national advertising. In addition, financial advertising was hurt by the stock market's plunge in late 1987. At the same time, competitive advertising from magazines and television and newer types of promotional media such as store displays and shopping carts had an impact. Finally, a 25% increase in postal rates in April 1988 probably did not help the situation.

These factors continued to hinder growth in newspaper ad lineage well into 1989. However, national advertisers were believed to be returning to run-of-paper (ROP) advertising because audiences for major television networks were steadily eroding.

Newspaper advertising revenues grew 6.1% in 1988, and they were projected to rise another 5% in 1989, according to data compiled by the Newspaper Advertising Bureau (NAB). Competition from other local media began to ease in the late 1980s, giving hope that newspapers would recapture some of their lost share of advertising dollars. While newspapers remain the leader in terms of advertising revenues, their share of total media advertising revenues has steadily contracted from 27.6% in 1980 to 26.3% in 1988.

Another trend likely to affect the long-term viability of newspapers is a steady decline in readership. Household penetration—the ratio of daily newspapers sold to number of households—dropped from 133 newspapers per 100 households in 1946 to 70 newspapers per 100 households in 1987. Each percentage-point drop in penetration correlates to a half-percentage-point loss in advertising share for newspapers.

As the volume of newsprint consumed by newspapers wanes, usage improves significantly among newspaper inserts, advertising shoppers, directories, magazines, paperback books, and free community weeklies. In 1988, these "uses other than daily newspapers" represented an estimated 26.6% of the total newsprint consumed, compared with 23.0% in 1980.

Preprinted inserts currently account for about 33% of all

ESTIMATED TOTAL MONTHLY NEWSPRINT INVENTORY HELD BY U.S. CONSUMERS

(000 metric tons/weeks of supply)

	1988		1987		1986		1985		1984		1983	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan.	1,431	43	1,324	41	1,413	45	1,429	46	1,257	42	1,254	45
Feb.	1,474	43	1,360	40	1,435	44	1,489	46	1,258	41	1,272	45
Mar.	1,512	44	1,367	40	1,405	42	1,541	48	1,221	38	1,247	42
Apr.	1,519	45	1,360	40	1,409	42	1,527	47	1,194	37	1,230	42
May	1,507	46	1,323	40	1,371	42	1,482	48	1,263	42	1,177	42
June	1,544	49	1,405	44	1,360	45	1,475	50	1,430	48	1,258	47
July	1,599	47	1,472	43	1,410	43	1,521	49	1,497	48	1,262	45
Aug.	1,615	46	1,457	41	1,438	43	1,563	48	1,508	47	1,311	43
Sept.	1,626	44	1,509	41	1,451	41	1,527	45	1,478	44	1,293	41
Oct.	1,517	43	1,442	39	1,392	40	1,506	44	1,453	42	1,234	38
Nov.	1,446	44	1,358	41	1,161	39	1,448	46	1,389	45	1,219	41
Dec.	1,469	46	1,411	45	1,269	42	1,394	46	1,335	45	1,179	42

	1982		1981		1980		1979		1978		1977	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan.	1,559	56	1,166	43	947	34	1,002	36	1,074	41	1,323	50
Feb.	1,634	58	1,234	44	1,036	36	1,029	36	1,084	40	1,366	49
Mar.	1,666	59	1,286	45	1,058	38	1,027	35	1,165	41	1,353	47
Apr.	1,629	59	1,311	46	1,097	40	950	33	1,130	41	1,326	46
May	1,598	62	1,312	49	1,147	43	907	34	1,156	44	1,250	46
June	1,565	62	1,395	54	1,195	47	938	37	1,207	48	1,268	49
July	1,530	57	1,462	54	1,208	45	991	37	1,194	47	1,261	47
Aug.	1,497	52	1,455	51	1,213	43	1,024	35	1,209	45	1,297	44
Sept.	1,423	48	1,460	49	1,212	40	938	31	1,195	42	1,262	40
Oct.	1,360	46	1,481	50	1,180	39	911	30	1,193	39	1,230	40
Nov.	1,328	47	1,480	54	1,092	39	881	31	1,050	37	1,206	42
Dec.	1,258	47	1,447	56	1,090	42	877	34	970	38	1,180	43

Source: Canadian Pulp & Paper Assn.

newspaper ad volume and 18.5% of all ad expenditures, but they bring in only about 10% of ad revenues, according to NAB. Over half of what advertisers spend on preprints goes to printers, and only 45% goes to newspapers. In a survey done by the Retail Advertising Conference in late 1988, participants said they planned to spend 55% of their 1989 ad dollars on newspapers—36.75% on ROP campaigns and 18.25% on inserts.

Newsprint prices. The industry has probably not experienced a pricing cycle as chaotic as the period from mid-1988 to mid-1989. Prices dropped by more than 8%, and discounts of 20% and higher were quoted on contract shipments. This climate was truly amazing, considering that mills were operating near capacity levels for much of the time. The market appeared to be in the grips of what some observers called "psychological factors," with both buyers and sellers acting in anticipation of the expansion cycle of 1989-91. There was widespread pre-selling of tonnage from new machines coming onstream, which forced existing producers to meet competitive discounts or risk losing volume.

Newsprint is a cyclical business. Capacity surges following periods of tight supply are well known to seasoned industry observers. The last great capacity surge began in late 1979 and ended in early 1983. The next four years were virtually flat. But between late 1987 and early 1988, newsprint profits soared, and companies began spending their available cash. The anticipation of future excess capacity eroded prices as early as March 1988—a year before startup of the first new newsprint machine. This downcycle should last through 1992.

Normally in soft markets, when demand is low and supplies are plentiful (such as in the early 1980s), prices either flatten or decline. Prior to the 1980s, North American newsprint prices were dominated by the actions of a few Canadian producers, generally called "the club" by U.S. publishers. A combination of rapid capacity expansion in North America and unusually strong North American currencies produced a surplus of U.S. and Canadian tonnage available for sale in the U.S. In addition, an influx of paper from previously less important sources such as Scandinavia, continental Europe, Latin America, and South Africa helped lead to the club's demise.

From 1981 until 1986, prices vacillated but remained virtually flat for the period due to deep discounting. Price increases were attempted at the same time that publishers were offered special cuts. After several failures to raise list levels in the mid-1980s, posted prices were successfully boosted during fourth-quarter 1986.

Newsprint producers pushed through a $35/metric ton price increase in late 1986 for a new list of US$570 in the eastern U.S. Another price increase in July 1987 raised list prices to $610 in the East and $600 in the West. On Jan. 1, 1989, producers implemented a $40 hike to $650 in the East and a $30 boost to $630 in the West.

Actual price increases were even larger as producers tightened up on discounts that had driven down transaction prices in 1986 to around $470 to $480/metric ton. Spot sales by both North American and offshore mills in the first half eroded prices to the low-$400s.

During 1982-86, overcapacity, combined with erratic U.S. economic growth and strong U.S. and Canadian currencies, hurt North American newsprint exports and drew

WORLD CAPACITY FOR NEWSPRINT

(000 metric tons)

Year	Canada	U.S.	Scandinavia	Western Europe (except Scandinavia)	Japan	Others	Total
1989p	10,325	5,715	4,855	3,640	3,535	7,041	35,111
1988	10,085	5,550	4,670	3,445	3,260	6,956	33,966
1987	9,925	5,450	4,550	3,182	2,865	6,720	32,692
1986	9,885	5,315	4,515	3,115	2,840	6,508	32,178
1985	9,820	5,300	4,525	2,915	2,780	6,006	31,346
1984	9,820	5,305	4,630	2,720	2,720	5,754	30,949
1983	9,970	5,235	4,685	2,475	2,730	5,467	30,562
1982	9,935	5,130	4,380	2,455	2,710	5,331	29,941
1981	9,490	4,950	4,045	2,405	2,885	5,031	28,806
1980	9,130	4,420	3,930	2,470	2,770	4,951	27,671
1979	9,065	3,810	3,860	2,405	2,710	4,586	26,436
1978	8,980	3,710	3,640	2,375	2,640	4,346	25,691
1977	8,985	3,690	3,430	2,250	2,480	4,205	25,040
1976	9,000	3,641	3,283	2,190	2,350	3,921	24,385
1975	8,974	3,582	3,088	2,506	2,296	3,526	23,972

p = Preliminary.

Source: Canadian Pulp & Paper Assn., *Newsprint Data*.

1988 NEWSPRINT EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

	Exporters				
Major importers	**U.S.**	**Canada**	**Sweden**	**Finland**	**Norway**
EUROPE					
Belgium	—	8	43	45	30
Denmark	—	—	111	89	37
France	—	31	119	116	35
Germany, Fed. Rep.	—	121	353	203	100
Greece	—	—	15	22	20
Ireland	—	3	—	17	—
Italy	—	3	50	20	28
Netherlands	—	21	116	50	65
Portugal	—	1	23	14	8
Spain	—	7	42	31	29
Sweden	—	—	—	2	—
U.K.	—	285	446	375	180
Yugoslavia	—	—	—	1	—
Other Europe	1	—	56	63	34
Total Europe	1	480	1,374	1,048	566
NORTH AMERICA					
Canada	5	—	—	—	—
U.S.	—	7,161	199	33	60
Total North America	5	7,161	199	33	60
ASIA/AUSTRALASIA					
Australia	1	115	—	13	17
China, People's Rep.	21	46	7	—	—
Hong Kong	34	34	9	8	2
India	—	84	3	3	2
Indonesia	1	—	—	—	1
Iran	—	—	13	—	—
Japan	217	131	19	3	1
Malaysia	23	26	9	3	4
New Zealand	—	8	—	—	—
Pakistan	—	8	—	—	—
Singapore	8	24	19	—	—
Taiwan	26	37	1	2	7
Thailand	5	15	4	1	16
Turkey	—	11	—	2	—
Other Asia/Australasia	16	2	74	63	22
Total Asia/Australasia	352	541	158	982	72
LATIN AMERICA					
Argentina	—	—	—	—	—
Brazil	—	51	—	9	2
Colombia	5	46	—	1	—
Costa Rica	1	10	—	—	—
Dominican Rep.	1	11	—	—	—
Ecuador	1	4	—	—	—
El Salvador	—	11	—	—	—
Guatemala	2	8	—	—	—
Mexico	2	9	—	—	—
Peru	—	13	—	1	—
Puerto Rico	—	70	—	—	—
Trinidad & Tobago	—	7	—	—	—
Venezuela	8	96	—	6	—
Other Latin America	2	22	1	—	—
Total Latin America	22	358	1	17	2
AFRICA					
Egypt	6	10	2	3	—
Nigeria	—	—	—	—	—
Other Africa	—	4	22	4	15
Total Africa	6	14	24	9	15
WORLD TOTAL	386	8,554	1,754	1,203	715

Source: *Pulp & Paper International*, Annual Review, July 1989.

imports from Scandinavia. The period began with an official list-price reduction from $500 to $468.50/metric ton in October 1982. The list was then raised to $535/metric ton in the third quarter of 1984, but this level was increasingly discounted until the end of 1986.

Such pricing caused the Canadian newsprint industry to decline sharply in the early 1980s. Jim Rowland of *Canadian Paper Analyst* estimated that pre-interest, pretax profit of Canadian producers on shipments to the U.S. declined from a high of about C$125/metric ton in 1980-81 to a low of $50 in 1983. It recovered to about $100 in 1986.

The success of the late-1986 price hike marked the dawning of a new cycle for the newsprint industry, one in which the producers would call the shots. Because of limited newsprint capacity expansions through the end of the decade, mills were expected to continue raising prices through 1988. However, price hikes failed in late 1988 and early 1989, and they were finally abandoned by mid-year. Instead, discounts grew. By summertime, a 19.2% discount was the going rate on contract orders of as little as 30,000 tons. Average orders were drawing discounts of 12% to 15%, and the largest buyers were able to negotiate prices 20% or more off of list price, which was $650/metric ton in the East and $630 (minus 5% "allowance") in the West.

As the 1980s drew to a close, the newsprint industry appeared to be embarking on an era when publishers could wield more influence on the marketplace. Not only were consolidations in the publishing business giving buyers more leverage in negotiating supply agreements, but many of the new mills coming online through 1991 were partially or wholly owned by publishing companies.

OUTLOOK

The outlook for newsprint through 1991 is bleak. Demand slowed down in mid-1988 and flattened through much of 1989. At the same time, about 2.5 million metric tons of new North American newsprint capacity began coming onstream, with 12 machines expected to start up during 1989-91.

Through the first three quarters of 1989, downtime was taken amounting to nearly 225,000 tons of newsprint production—almost entirely in Canada. This helped bolster the market somewhat, but it was not enough to prevent prices from continually sliding. A seasonal pickup in demand late in the third quarter allowed mills to return to more normal operating schedules, and the slide in prices stopped. Demand, however, was expected to drop off again in early 1990, and prices could dip further.

Forecasters expected 1990 North American operating rates in the high 80s to low 90s, as newsprint capacity that came onstream in 1989 built up speed and was joined by four newsprint machines in 1990 and another three machines in 1991.

Total Canadian newsprint shipments in 1988 were up 1.1% to 9.9 million metric tons. While shipments to the U.S. were flat at 7.1 million tons, offshore shipments increased 4.5% to 1.5 million tons, and domestic shipments were up 3.7% to 1.3 million tons. In 1989, total Canadian shipments were projected to be down about 1.6%, with demand from the U.S. slightly lower than the decline in exports to destinations outside North America.

This level of Canadian shipments should result in a 1989 operating rate of about 95%—down from 98.8% in 1987 and 97.4% in 1986. Demand for Canadian newsprint will be

WORLD DEMAND FOR NEWSPRINT

(000 metric tons)

Year[1]	North America	Western Europe	Asia, Africa, Oceania	Eastern Europe	Latin America	Total
1988	13,622	7,337	7,082	2,081	1,546	31,668
1987	13,649	6,799	6,368	2,019	1,552	30,387
1986	12,933	6,432	6,215	1,929	1,506	29,015
1985	12,684	6,108	6,117	1,896	1,271	28,076
1984	12,651	6,023	6,847	1,825	1,184	28,530
1983	11,479	5,574	5,567	1,761	1,760	26,141
1982	10,822	5,424	5,333	1,669	1,184	24,432
1981	11,593	5,570	5,651	1,707	1,538	26,059
1980	11,280	5,640	5,318	1,647	1,326	25,211
1979	11,075	5,355	5,166	1,694	1,192	24,482
1978	10,700	5,079	4,872	1,683	1,088	23,422
1977	9,966	4,796	4,624	1,716	1,169	22,271
1976	9,821	5,092	4,311	1,694	962	21,880
1975	9,029	4,975	4,064	1,670	924	20,662
1974	10,437	5,622	3,672	1,613	1,358	22,702
1973	10,661	5,497	3,446	1,532	1,264	22,400
1972	10,059	5,100	3,388	1,509	1,295	21,351
1971	9,517	4,979	3,263	1,467	1,285	20,511
1970	9,533	5,269	3,173	1,418	1,449	20,842
1969	9,688	5,113	2,958	1,337	1,297	20,393
1968	9,080	4,553	2,595	1,264	1,184	18,676
1967	8,887	4,222	2,355	1,200	1,084	17,748
1966	8,998	4,419	2,077	1,095	985	17,574

[1] Figures prior to 1974 do not include People's Rep. China.

Source: Canadian Pulp & Paper Assn., *Newsprint Data*.

further eroded by flat U.S. newsprint consumption, inventory drawdowns by publishers, and additional capacity expansion by U.S. newsprint producers.

Publishers lowered their inventories in 1989 because of plentiful newsprint supplies and declining newsprint prices. In 1990, stocks may be built up again because labor contracts involving most mills in eastern Canada are up for renewal. Negotiations are expected to begin sometime in the second quarter.

One factor that could improve demand is an unusually wide price gap of $100/ton or more between newsprint and higher groundwood grades. This could encourage substitution of newsprint for coated groundwood and sc paper in inserts and other commercial printing applications.

In 1988, U.S. newsprint mills increased shipments by nearly 2% to 5.4 million metric tons, resulting in an operating rate of 97.8%. In 1989, U.S. newsprint shipments should be relatively flat, with operating rates dropping to

NEWSPRINT PRICES, 30-LB DELIVERED

(U.S. $/metric ton)

	Eastern			West Coast		
Year	List	Transaction	Effective	List	Transaction	Effective
1989						
2Q	$650	$575		$630	$560	
1Q	650	585/612		630	580	
1988						
4Q	650	600		630	590	
3Q	650	610		630	598.50	
2Q	650	610		630	598.50	
1Q	650	610	1/1-3/1	630[1]	598.50	1/1-2/1
1987						
4Q	610	570		600[2]	552.90	
3Q	610	570	7/1-9/1	600	552.90	7/1
2Q	570	553/550		570	514.50	
1Q	570	530/550		570	514.50	
1986						
4Q	570	500/550	10/1-12/30	570	514.50	10/1
3Q	535	500/535		535	508.25	
2Q	535	480/535		535	508.25	
1Q	535	500/535		535	508.25	
Year-end						
1985	535	505		535[3]	508.25	
1984	535	510	7/1	500/535	508.25	3/1, 10/1
1983	500	475	9/1	468.50[4]	445	
1982	468.50	445/468.50	11/1	468.50	445	8/1
1981	470/500	490	1/1, 8/1	470/500	470	1/1, 8/1
1980	440	440/470	5/1	440	440	5/1
1979	380/413	380/413	1/1-2/1, 10/1-11/1	380/413	380/413	1/1-2/1, 10/1-12/1
1978	353	353	2/1-4/1	353	353	4/1
1977	336	336		331	331	
1976	314/336	314	3/1, 11/1-12/1	331	331	7/1
1975	287	284	1/1	309	309	1/1
1974	259	259	7/1	270	270	8/1
1973	199/206/235*	220	2/1, 6/1, 11/1	197/235	197/235	1/1, 9/1-12/1
1972	194*	182	2/1	192	192	1/1
1971	188*	176	4/1	182	182	1/1
1970	179*	168	1/1	173	173	1/1

* Prices are for paper made by Canadian mills; prices in these years for southern-manufactured paper are generally about $2 lower. Effective dates for Canadian and southern mills are generally the same, except for 1972, when southern price took effect a month later on 3/1.

1. Discount of 3% dropped effective 1/1/88, leaving a 5% discount.
2. One previously implemented 5% discount reduced to 3%, effective 7/1/87.
3. A second 5% discount added by West Coast producers, effective 10/1/85.
4. West Coast producers announced 5% discount from list, effective 7/1/83.

Sources: American Newspaper Publishers Assn., *Pulp & Paper Week.*

about 95% because of new newsprint capacity.

Operating rates of 95% and below usually signal the start of a buyer's market, where producers compete with each other on prices in order to protect their market shares. The situation is expected to get even more competitive in 1990, as operating rates dip even lower.

A long-term forecast done for ANPA in 1986 by Jon G. Udell notes, "The future outlook for U.S. newspapers is favorable even though the U.S. economy may experience some difficult days in the years ahead. If difficulty does not occur, the 14.5-million-ton trend projection for 1995 will be exceeded. In fact, if newspaper and newsprint consumption were to repeat the growth rates of 1975-85, U.S. newsprint consumption would reach 16.3 million metric tons in 1995. However, one can strongly question whether newsprint supply would allow such a rapid expansion."

In a more recent update of that study conducted in December 1988, Udell's 1995 forecast remains the same, but he is less optimistic about newsprint consumption tracking the U.S. economy. "The dynamics of the newsprint industries may reduce the future rise of U.S. newsprint consumption," he said. "The cost of newsprint, as well as other newspaper operating costs, will play a significant role in the future rise of newsprint consumption."

Edmund W.E. Hughes, vice president, east, of Canadian Pacific Forest Products Ltd., predicted that consumption

EXPORT PRICES FOR NEWSPRINT IN SELECTED MARKETS

(per metric ton)

	Canada to U.K.[1]		Finland to U.K.[2]	
	C$	US$	£	US$
1989				
2Q	n.a.	n.a.	£425*	US$714.64
1Q	C$723.36	US$606.24	425	717.74
1988				
4Q	733.07	614.63	425	769.04
3Q	753.80	619.34	425	716.34
2Q	763.23	629.36	400/425	705.09
1Q	698.56	566.05	400/425	775.42
1987				
4Q	670.06	515.51	400*	748.60
3Q	657.92	502.57	400*	651.88
2Q	677.75	509.13	400*	644.00
1Q	656.03	502.67	365*	585.83
1986				
4Q	621.50	450.20	365*	538.19
3Q	674.25	485.60	345	500.25
2Q	563.05	406.04	345	527.95
1Q	603.07	431.60	345	512.43
Year-end				
1985	622.79	445.65	345	498.35
1984	489.17	370.19	321	371.24
1983	527.75	424.10	300	435.18
1982	606.44	493.28	300	484.35
1981	615.37	518.91	300	572.40
1980	631.44	528.53	270	643.95

* Discounting from list prices reported.
n.a. = Not available.
1. F.o.b. point of lading, 30-lb.
2. Delivered to U.K. pressroom, 48.8-g/m^2.

Sources: *Statistics Canada, Pulp & Paper International.*

LARGEST U.S. DAILIES AND 1987 NEWSPRINT USAGE

Newspaper	Circulation[1]	Newsprint consumption[2] (metric tons)
Wall Street Journal	2,025,176	173,942
USA Today	1,345,721	140,000
New York Daily News	1,283,302	176,610
Los Angeles Times	1,132,920	419,000
New York Times	1,078,443	353,200
Washington Post	810,011	244,942
Chicago Tribune	774,045	210,686
Detroit News	688,211	128,964
Newsday	665,218	152,432
Detroit Free Press	647,763	93,631

1. From Audit Bureau of Circulation figures as of Mar. 31, 1988.
2. Independent verification.

Source: "Newspaper and Newsprint Facts at a Glance," from Newsprint Information Committee.

U.S. NEWSPRINT CONSUMPTION, DAILIES vs OTHER USES

(000 metric tons)

Year	ANPA "525"	Other dailies	Other uses	Total consumption
1988	7,548	1,663	3,126	12,337
1987	7,606	1,519	3,198	12,323
1986	7,422	1,443	3,072	11,937
1985	7,199	1,525	2,863	11,587
1984	7,075	1,457	2,899	11,431
1983	6,638	1,260	2,700	10,598
1982	6,358	1,249	2,501	10,108
1981	6,506	1,307	2,351	10,164
1980	6,581	1,208	2,299	10,088
1979	6,673	1,208	2,318	10,199
1978	6,446	1,174	2,257	9,877
1977	6,143	1,084	2,052	9,279
1976	5,928	1,020	1,771	8,719
% change 1976-88	27.3%	63.0%	76.5%	41.5%

Source: American Newspaper Publishers Assn.

patterns of newspaper publishers and other newsprint customers will change significantly in the years ahead. As a result, GNP will no longer be the guiding factor in newsprint consumption.

Consumption by users other than daily newspapers will grow from about 25% in 1988 to about 31% in the year 2000. These specialized publications (weeklies, shoppers, etc.) will be differentiated by a wide variety of quality specifications, the upper limits of which no newsprint mill in North America currently comes close to, said Hughes.

Overseas markets. World demand for newsprint in 1988 reached 31.7 million metric tons, according to CPPA. The Food & Agriculture Organization of the United Nations predicted that world consumption will grow to about 42 million tons in the year 2000. CPPA expected Canadian newsprint shipments to rise during this time to 12 million tons.

The largest share of total 1988 North American newsprint exports to offshore customers was from Canada. In fact, Canada shipped more than four times as much newsprint overseas as did the U.S. Offshore exports of U.S. newsprint, however, grew between 1980 and 1988 from 176,000 metric tons to 381,100 tons. For the same period, Canadian newsprint exports to offshore destinations were up slightly from 1.524 million metric tons to 1.554 million tons.

Exports to western Europe from Canada declined between 1980 and 1986, but began growing again in 1987. In 1988, they reached a new peak of 582,000 metric tons, with over 60% of that amount sold to the U.K. Exports to Asia were up nearly 12% to 434,000 tons, while the Oceania region imported 129,000 tons of Canadian newsprint in 1988—up more than 15% from the previous year. However, shipments from Canada to Latin America dropped by more than 6% to 393,000 tons. And the African market has dried up, with just 13,000 tons shipped to that continent from Canada in 1988.

Since 1980, Scandinavian producers have had an edge in trading with western Europe. During that time, the European Economic Commission imposed a tariff-free import quota of 650,000 metric tpy of newsprint not produced by EEC countries; newsprint from Scandinavia entered western Europe tariff-free.

Exports to the U.K. from Canada dropped significantly in the mid-1980s, due not only to falling newspaper circulation but also to currency exchange rates, increased imports from Scandinavia, and increased production within the U.K. This trend continued in the late 1980s.

With Japanese newsprint consumption projected to rise over the next few years, North American producers have an expanded market to cultivate there. They should have an advantage over other global suppliers because of Japanese ownership in several U.S. and Canadian newsprint mills.

Japan is already a leading customer for the U.S., with Jujo Paper Co. Ltd.'s 20% interest in the North Pacific Paper Corp. mill at Longview, Wash., and Daishowa America Inc.'s ownership of the Port Angeles, Wash., mill. In Canada, Oji Paper Co.'s 50% partnership with Canfor Corp. in the new Howe Sound venture will have a significant effect on where that mill's output is marketed.

Rep. Korea is likely to become a bigger exporter of newsprint in 1990-92, when two expansions amounting to about 200,000 tpy of new capacity are scheduled to come online. Based on a 15% annual growth rate projected by Goldman Sachs over the 1989-91 period and an 85% operating rate, Rep. Korea's newsprint exports will jump 47.5% from 1988 to 1991—from 20,000 tons to 115,000 tons.

In early 1992, Venezuela will bring online a new 200,000-tpy newsprint mill—that country's first. This startup will displace not only 150,000 tpy of imported newsprint now required for Venezuelan domestic consumption, but also 50,000 tpy used by the surrounding countries of Colombia, Guyana, Surinam, and Brazil, according to Goldman Sachs.

MEDIA SHARE OF U.S. ADVERTISING REVENUES

	1988		1987		1978		1970	
	$ million	%	$ million	%	$ million	%	$ million	%
Daily newspapers	$31,197	26.3%	$29,412	26.8%	$12,690	29.0%	$5,745	29.3%
Magazines	6,055	5.1	5,607	5.1	2,595	5.9	1,323	6.8
Television	26,040	22.0	23,904	21.8	8,850	20.2	3,665	18.7
Radio	7,745	6.5	7,206	6.6	2,995	6.8	1,278	6.5
Direct mail	21,215	17.9	19,111	17.4	6,030	13.8	2,734	13.9
Business publications	2,580	2.2	2,458	2.2	1,420	3.2	740	3.8
Outdoor	1,055	0.9	1,025	0.9	465	1.1	234	1.2
Others	22,335	18.9	20,731	18.9	8,735	20.0	3,881	19.8
Total	118,442		109,650		43,740		19,600	

Sources: McCann-Erickson Inc., Newspaper Advertising Bureau Inc.

COMPARATIVE NEWSPRINT MANUFACTURING COSTS FOR MAJOR PRODUCING REGIONS, 1987

(US$/metric ton)

	Canada	U.S. West	U.S. South	Finland	Sweden
Furnish material	$121	$139	$107	$236	$193
Energy	57	69	71	93	90
Labor	88	55	73	48	57
Other	55	57	86	59	67
Mill level cost	321	320	337	436	406
Corp./selling cost	20	8	17	34	20
Cost before delivery	341	328	354	469	426
Delivery	65	44	30	83	63
Total delivered cost	405	372	384	552	490

Source: Forest Sector Advisory Council of Canada, "Newsprint Cost Study, 1983-87."

HISTORICAL TREND IN TOTAL NEWSPRINT DELIVERED COST, 1982-89

(US$/metric ton)

	1989*	1987	1986	1985	1984	1983	1982
Canada	$474	$405	$381	$379	$385	$407	$408
U.S. West	405	372	368	378	388	370	387
U.S. South	418	384	351	379	384	379	368
Finland	547	552	440	409	331	369	384
Sweden	477	490	418	382	306	312	322

* *Pulp & Paper Week* estimate based on exchange rate in May 1989 and including effect of inflation.

Source: Forest Sector Advisory Council of Canada, "Newsprint Cost Study" for 1982-86 and 1983-87.

Paper:

UNCOATED GROUNDWOOD

Uncoated groundwood papers are considered value-added relatives of newsprint because they have similar physical properties and use primarily stone groundwood pulp. However, uncoated groundwoods have better printing characteristics and are priced above standard newsprint. They fall between newsprint and coated paper as an intermediate printing medium, with the exception of the small groundwood forms paper sector, which competes with uncoated free-sheet forms bond. Groundwood forms production reached 170,000 short tpy in 1989.

Brightness further distinguishes uncoated groundwoods from competing products. Uncoated groundwood grades are brighter than newsprint, starting at about 64 Elrepho and going as high as 72. By contrast, newsprint brightness falls between 56 and 62 Elrepho. Brightness ratings for uncoated groundwoods are below those of coated groundwoods, which are in the low to mid-70s. Uncoated groundwoods are also considered to be below coated groundwoods in overall printing qualities.

Companies with strong positions in newsprint became the first major producers of groundwood papers, often by converting older newsprint machines, a trend still common in Canada. In recent years, a few new machines have been installed. Greenfield mills have also been built, such as Lake Superior Paper Industries at Duluth, Minn. Conversions have been fueled by overcapacity in newsprint and by customer demands for papers with better appearance characteristics. A newsprint machine's output can be upgraded to uncoated groundwood by adding fillers, using more chemical furnish, and adding on-machine calendering or off-machine supercalendering.

STATISTICS FOR UNCOATED GROUNDWOOD PAPER*

	1989e	1988r	1987r	1986	1985
UNITED STATES					
Production, 000 tons	1,684	1,598	1,485	1,540	1,521
Capacity[1], 000 tons	1,762	1,696	1,653	1,685	1,644
Utilization rate, %	95.6	94.2	89.8	91.4	92.5
Imports, 000 tons	1,470	1,404	1,270	1,028	1,027
Exports, 000 tons	71	66	56	41	37
Apparent U.S. consumption					
000 tons	3,083	2,936	2,699	2,527	2,511
lb/capita	24.83	23.86	22.13	20.98	21.05
000 tons/$ billion real GNP (1982)	1.51	1.46	1.40	0.68	0.70
CANADA[2]					
Production, 000 tons	1,822	1,641	1,498	1,343	1,146
Capacity, 000 tons	1,884	1,648	1,499	1,391	1,146
Exports, 000 tons	1,474	1,328	1,256	1,138	992
Utilization rate, %	96.7	99.6	99.9	96.5	100.0

* All tons are short tons.
e = Estimate.
r = Revised.
1. American Paper Institute.
2. Canadian Pulp & Paper Assn.

Supercalendered (sc) papers were pioneered by the Europeans, particularly the Scandinavians. sc papers come in essentially three grades: unfilled sc-c, low-filled sc-b, and high-filled sc-a, which is the grade that competes most directly with coated No. 5. The Finnish mills Kymmene Corp., United Paper Mills Ltd., and Tampella Ltd. offer or plan to introduce an intermediate grade between sc-a and coated No. 5. Kymmene and UPM shipped 35,000 tons of this on-machine-coated, lightly pigmented lightweight grade to the U.S. in 1987. Other mills in Fed. Rep. Germany, Austria, and Finland also planned to ship the new coated groundwood grade.

Technology for premium sc has also advanced. Abitibi-Price Inc. offers a wsop (web-sized offset paper) that is licensed to Abitibi by Metsäliiton Teollisuus Oy of Finland. The rebuilt paper machine at the Kenogami mill in Jonquière, Que., produces about 70,000 tons of this paper when operating at full capacity. Lake Superior, a project of Pentair Inc. and Minnesota Power, uses technology from the German Haindl Papier GmbH to make up to 240,000 short tpy of premium sc paper. The Duluth, Minn., mill began operations in November 1987, and a second machine appears likely.

End uses for uncoated groundwood, with approximate 1988 North American demand estimates, include the following: catalog, 488,000 tpy; directory, 643,000 tpy; newspaper inserts and direct-mail advertising circulars, 1.2 million tpy; periodicals (magazine and Sunday supplements), 620,000 tpy; business papers, including forms and carbonless basestock, 368,000 tpy; and miscellaneous (books, basestock for converting, and exports), over 1.2 million tpy. Basis weights range from 18 to 40 lb (24 x 36 in., 500 sheets) or 30 to 66 g/m^2.

The primary consumers of catalog-grade papers are large retailers such as Sears, Roebuck & Co., Spiegel, and J.C. Penney, plus 6,500 specialty stores, mail-order houses,

U.S. PRODUCTION AND CAPACITY FOR UNCOATED GROUNDWOOD PAPER

(000 short tons)

	Production		
Year	Census	API[1]	Capacity[2]
1991	—	1,751e	1,875
1990	—	1,706e	1,765
1989	—	1,684e	1,762
1988	—	1,601	1,696
1987	1,485	1,485	1,653r
1986	1,539r	1,540	1,685
1985	1,521r	1,521	1,710
1984	1,565r	1,565	1,622
1983	1,604	1,531	1,642
1982	1,499	1,471	1,655
1981	1,428	1,471	1,625
1980	1,538	1,499	1,624
1979	1,800	1,509	1,537
1978	1,636	1,354	1,453
1977	1,589	1,360	1,367
1976	1,560	1,321	1,309
1975	1,294	1,127	1,329
1974	1,411	1,192	1,280
1973	1,416	1,181	1,403
1972	1,308	1,126	1,442
1971	1,186	1,089	1,363
1970	1,214	1,085	1,230
1969	1,208	1,095	1,296

e = *Pulp & Paper* estimate.
r = Revised.
1. Shipments.
2. American Paper Institute, 1988.

Sources: American Paper Institute, Bureau of the Census, *Pulp & Paper Forecaster.*

UNCOATED GROUNDWOOD PAPERS TYPICAL GRADE STRUCTURE

Grade	Basis weight[1]
Rotogravure[2] (standard, premium, high brightness)	33, 35 lb (25 x 38 in., 500 sheets)
Offset[2] (premium, high brightness)	28, 35, 38, 45 lb (25 x 38 in., 500 sheets)
Magazine (gravure, offset)	35 lb (25 x 38 in., 500 sheets)
Paperback/book	35, 37 lb (25 x 38 in., 500 sheets)
Directory (white, yellow)	20, 22.5 lb (24 x 36 in., 500 sheets)
Computer	15, 18 lb (17 x 22 in., 500 sheets)

1. Typical weights offered by producers. Other weights may be available.
2. Catalog grades.

GPO MINIMUM ACCEPTABLE PROPERTIES FOR GROUNDWOOD PAPER FORMS

Basis weight				
lb*	12	15	18	20
g/m²	45	56	68	75
Burst	7	8	11	14
Opacity, %	80	80	80	80
Caliper				
0.001 in.	2.8	3.5	4.2	4.6
mm	0.071	0.089	0.109	0.117

* Ream size: 17 x 22 in., 500 sheets.

and other merchandisers. A study in the mid-1980s estimated that 1.9 million tons of paper were used in catalogs. About 13.7% was SC, 9.5% machine-finished (MF), 40% coated No. 5, and 33.4% coated Nos. 3 and 4.

Rotogravure and offset processes are used to print catalogs, although gravure printing is favored for longer runs because of its economic advantages. Catalog publishers have shifted from uncoated groundwood to LWC paper, or from LWC to coated free-sheet, in order to enhance appearance. Traditional catalog paper, which is similar to lightweight newsprint or telephone directory paper, has also been hurt by competition from SC. Some mass marketers still use lower-quality grades, such as high-brightness newsprint and standard newsprint, when quality of image is not important (e.g., J.C. Whitney & Co. Inc.'s auto parts catalog).

Telephone directory paper has a lower gloss and brightness than catalog paper, and for telephone books it is generally made with a 22- to 23-lb basis weight, although some publishers use 20 lb and 18 lb paper. The breakup of American Telephone & Telegraph Co. and court decisions to allow widespread use of the Yellow Pages name and logo at first spurred growth in independent and specialized directories, such as Business-to-Business, Silver Pages (for senior citizens), and ethnic or market-related books. However, the last few years have brought a shakeout to the directory publishing industry, with small books and a few big ones like the Silver Pages being discontinued or purchased by larger companies.

"Many publishers for the Regional Bell Operating Companies (RBOC) have withdrawn from competitive or specialty markets . . . and renewed their focus on the core yellow page product within their own 'Bell-sanctioned' markets," said Douglas Parker, manager of paper administration for US West Direct. Speaking at *Pulp & Paper*'s Fourth Groundwood Papers Conference in October 1989, Parker said that independents, including those owned by RBOCs, have withdrawn from markets that were unprofitable or stagnant. The defections followed a downturn in general advertising.

Around 675,000 tons of directory paper were purchased annually by North American directory printers and publishers between 1986 and 1989—up from 588,000 tons in 1985.

Publishers have cut costs by reducing the size of their books. One method is to make better use of layout to eliminate filler ads, according to Larry Small, marketing manager for the Yellow Pages Publishers Assn. He also said that fewer white pages directories will be published as the costs of production rise. In 1987, about 6,500 volumes were published, and the number has dropped to 6,200 since then. "Within the last two years, there's been a pretty good shakeout," Small said.

Some publishers are shifting to coated glossy stock for printing special sections. Advances in printing technology and demands for better printing quality also could change the outlook for directory paper stock. Four-color printing and growing use of cover advertisements and inside coupons all increase the need for stronger and brighter papers.

SC paper currently accounts for about 31% of the uncoated groundwood segment—up from 12% at the beginning of the 1980s. Its share should increase to nearly 40% by 1998. With 1.2 million tons consumed in 1988, SC is becoming a major commodity grade in uncoated groundwood markets. It is used primarily for magazines in Europe and for advertising inserts, flyers, periodicals, and newspaper supplements in North America. Major producers and their capacities are Lake Superior Paper Industries, 240,000 tpy;

ESTIMATED CAPACITIES OF MAJOR COMPANIES FOR UNCOATED GROUNDWOOD PAPER

(000 short tons)

	1989 annual capacity		North American market capacity	
Company	U.S.	Canada	Total	%
1. Abitibi-Price	—	525	525	12.1%
2. MacMillan Bloedel	—	444	444	10.2
3. Canadian Pacific Forest Products	—	430	430	9.9
4. Consolidated-Bathurst[1]	—	423	423	9.7
5. Great Northern Nekoosa[2]	288	—	288	6.6
6. Boise Cascade	—	270	270	6.2
7. Lake Superior Paper	240	—	240	5.5
8. Champion International	239	—	239	5.5
9. Domtar	—	190	190	4.4
10. St. Marys Paper	—	185	185	4.3
11. Madison Paper	175	—	175	4.0
12. Kimberly-Clark	131	41	172	4.0
13. James River	148	—	148	3.4
14. Fraser	135	—	135	3.1
15. Daishowa America	130	—	130	3.0
16. Kruger	—	55	55	1.3

North American capacity (1989): 4.346 million tons
U.S., 1.762; Canada, 2.584[3]
Capacity share of top five companies: 48.6%
Capacity share of top ten companies: 74.2%

[1] Subsidiary of Stone Container Corp.
[2] Millinocket, Maine.
[3] Probably underestimated by 200,000 to 1 million tons.

Madison Paper Corp., 165,000 tpy; Champion International Corp., 120,000 tpy; St. Marys Paper, 125,000 metric tpy; Abitibi-Price, 140,000 metric tpy; and Kruger Inc., 50,000 metric tpy.

European publishers have shown much broader acceptance of sc papers for consumer and trade magazines. Although relatively new to the North American market, sc papers have begun to catch on with publications such as *Parade*. In 1987, about 277,000 tons of sc paper were used for Sunday magazines and supplements, much of it by the *New York Times*. Inserts and flyers consumed about 541,000 tons, and catalogs used 325,000 tons. The remainder, about 62,000 tons, went to book publishers and to commercial printers for jobs other than inserts/flyers.

sc papers have a clay content ranging from almost nothing to 25% or more. Clay (kaolin) and other pigments enhance appearance by adding brightness, opacity, strength, and bulk. Use of kaolin pigments in groundwood papers has grown because of advertiser demands for better paper quality, according to C.D. Richardson, director of sales in the U.S. and Canada for Engelhard Corp. Richardson told delegates at the *Pulp & Paper* Groundwood Papers Conference that sc papers have basis weights ranging from 41 to 82 g/m², and they contain at least 50% mechanical pulp, with the balance made up of chemical fiber. Filler content is usually between 15% and 30%.

The calendering process, which is evolving from "hard" to "soft" calendering, also affects the quality of sc paper. All of these papers are called "smooth papers" by John G. Davis, executive vice president of printing papers at Abitibi-Price. He told conference delegates that smooth papers will grow 8% to 10% annually during the next five to ten years—far more than any other groundwood grade and even higher than the 5% to 6% expected for LWC papers.

The groundwood forms market is doing less well. Davis projected "fair" growth of 3% to 5%/year—substantially below the growth rate of five or ten years ago. Even though the forms market as a whole will grow, the groundwood segment will probably decline as a percentage of the total. In 1988, shipments of groundwood papers fell 25% from

UNCOATED GROUNDWOOD PAPERS: CANADIAN PRODUCTION, EXPORTS, AND CAPACITY

(000 short tons)

Year	Production[1]	Exports[2]	Capacity[1]
1989e	1,822	1,474	1,884
1988	1,641	1,328	1,648
1987r	1,498	1,256	1,499
1986	1,343	1,138	1,391
1985	1,146	992	1,146
1984	1,000	845	1,020
1983	843	575	882
1982	715	460	827
1981	711	320	728
1980	677	305	728
1979	625	321	702
1978	580	266	675
1977	463	193	560
1976	363	133	480
1975	315	140	402
1974	401	183	440
1973	319e	184	412

e = *Pulp & Paper* estimate.
r = Revised.
1. Canadian Pulp & Paper Assn.
2. *Statistics Canada.*

UNCOATED GROUNDWOOD EXPANSIONS

Company	Location	Annual short tons	Startup	Nature of work
Abitibi-Price	Jonquière, Que.	65,000	[1]1987	Convert to WSOP SC
Lake Superior Paper	Duluth, Minn.	240,000	1987	New SC mill
Abitibi-Price	Alma, Que.	65,000	1988	Convert to LW catalog and directory
St. Marys Paper	Sault Ste. Marie, Ont.	172,000	1988	Build new SC machine
F.F. Soucy	Rivière-du-Loup, Que.	22,000	1989	Rebuild news/groundwood machine
Kruger	Trois Rivières, Que.	30,000	1989	
Stone-Consolidated	Trois Rivières, Que.	33,000	1989	
Stone-Consolidated	Grand'Mère, Que.	183,000	1990	Build new specialties machine
Kruger	Corner Brook, Nfld.	77,000	1990	
Daishowa America	Port Angeles, Wash.	150,000	proposed	Build new directory machine
Lake Superior Paper	Duluth, Minn.	245,000	proposed	
Cascades	Port Cartier, Que.	210,000	proposed	
Madison Paper	Madison, Maine	n.a.	n.a.	

n.a. = Not available.
1. Mill closed in mid-1989 due to financial difficulties.

Sources: *Pulp & Paper Week*; *Pulp & Paper Project Report.*

1987 levels, and they accounted for 6% of total forms shipments, compared to 8% in 1987.

Groundwood forms are used for less important computer printouts, such as internal sales documentation and reports, and they are priced as much as $200/ton less than free-sheet forms bond. A free-sheet/groundwood blend used by some major U.S. formsmakers is priced between the two grades.

The trend toward cut-sheet printers is also reducing the groundwood forms segment because nearly all of the cut-size market is free-sheet. However, the addition of new fibers such as chemi-thermomechanical pulp (CTMP) provides a better sheet than standard groundwood forms, but at a lower cost than free-sheet. CTMP-based papers are more prone to brightness reversion (discoloring of paper as it ages) than free-sheet, but less so than groundwood.

Groundwood-based forms bond is divided into three categories. The first is low-content groundwood papers, which contain from 10% to 50% groundwood fiber and have brightness levels ranging from 72 to 77. In computer applications, these papers are similar to uncoated free-sheet and forms bond in appearance and performance. They often are used in lieu of register bond in stock continuous forms, and colored papers in this grade sometimes are substituted for colored free-sheet papers. The second—and largest—category consists of papers with over 50% groundwood content and low brightness of about 65. The third category contains papers used as basestock for carbonless forms. Called low-ply chemical carbonless papers, they range in brightness from 70 to 74, and they are used primarily for multiple-part stock continuous forms.

Compared with free-sheet forms bond, groundwood forms bond has a lower brightness level and a tendency to age rapidly. Uncoated free-sheet is still preferred for archival purposes or for external presentation. Thus, custom continuous forms often use free-sheet, while groundwood is acceptable for internally used and quickly discarded stock continuous forms.

The cyclical nature of the market in terms of supply and demand encouraged some converters in 1973-74 to consider groundwood as an alternative. However, groundwood paper at that time had significant problems, including poor refoldability, which can slow down operations of a high-speed printer; lint on the sheet surface, which wears out printer ribbons faster than normal; inadequate internal strength, causing line holes to rip apart on some fast printers and leading to paper jams; inability to punch cleanly, leaving punch holes (chad) to jam the printer; and abrasiveness, which causes converters' line hole punches and perf blades to wear out more quickly than with free-sheet forms paper. Groundwood pulps have improved substantially since then due to advances in cleaning and refining.

PRODUCTION, CAPACITY

Canadian mills produced most of North America's uncoated groundwood paper tonnage during the past two decades, as they did with newsprint, groundwood's lower-value sister. That is because many newsprint mills were converted to production of groundwood specialties. At first, these mills made rotogravure newsprint, MF offset, and lightweight news (telephone directory paper). U.S. production of uncoated groundwood papers generally climbed during the 1970s and 1980s, except for slight drops 1980-83 and in 1987. Canadian uncoated groundwood paper production increased more steadily during the past decade. Of course, much of the Canadian tonnage was shipped to the U.S., as was newsprint.

The American Paper Institute reported U.S. mill production (measured by shipments) as slightly less than 1.2 million tons in 1973. It jumped to 1.5 million tons in 1983, and was expected to reach almost 1.7 million tons in 1989. Similarly, Canadian mills produced about 319,000 tons in 1973, compared with 843,000 tons in 1983 and an estimated 1.8 million tons in 1989. However, the early figures for Canada are probably too low, as a large amount of groundwood paper (rotonews) was actually classified as newsprint in order to gain the duty-free status of newsprint.

Uncoated groundwood capacity at U.S. mills was about 1.4 million tons in 1973, 1.6 million tons in 1983, and an estimated 1.7 million tons in 1989. Canadian mills had capacity for 412,000 tons in 1973, 882,000 tons in 1983, and almost 1.9 million tons in 1989. As with production, Canadian capacity is probably 25% higher than industry figures.

Very little major new capacity is scheduled to come online in the next few years, with the exception of Stone-Consolidated Inc.'s new machine at Grand-Mère, Que. Lake Superior has postponed at least until 1990 its decision to add a second 240,000-tpy SC machine at Duluth, Minn., because of weaker market conditions and other factors. Most of the additional tonnage will come from improvements of existing groundwood machines and conversions of small machines.

LIGHTWEIGHT (CATALOG/DIRECTORY) PAPER CAPACITIES IN NORTH AMERICA*

(000 short tons)

Company	Capacity	Mill producing
MacMillan Bloedel	220	Port Alberni, Powell River, B.C.
Great Northern Paper[1]	169	Millinocket, Maine
Daishowa	141	Port Angeles, Wash.
Fraser[2]	130	Madawaska, Maine
Abitibi-Price	107	Alma, Jonquière, Que.
Champion International[3]	90	Lufkin, Texas; Deferiet, N.Y.
Stone-Consolidated[4]	72	Trois Rivières, Que.
James River[5]	35	Clatskanie, Ore.

* = 1989 estimated.

[1] Great Northern Nekoosa Corp. Also has newsprint machines qualified for directory at East Millinocket, Maine.

[2] Owned by Noranda Forest Inc.

[3] St. Regis Div.

[4] Also has swing capacity on other machines.

[5] *Pulp & Paper* estimate; total machine capacity is 140,000 tpy.

Sources: Company data; *Pulp & Paper* estimates.

OUTLOOK

Substantial groundwood capacity additions of new SC, LWC, and European intermediate grades (so-called No. 6) have led some forecasters to temper their optimistic predictions of a booming industry. By mid-1989, the crunch in newsprint was affecting prices for groundwood grades, causing general discounting across the board. While most groundwood mills have not become unprofitable, they have been forced into much stronger competition than they expected. Because of the relative weakness in demand, mills are scrutinizing their operations for ways to improve efficiency. At least one industry executive thinks it is time mills retired some of the older groundwood machines that can no longer be rebuilt with satisfactory financial returns.

"What do we do with this mill, now 50 or 60 years old?" asked John G. Davis, executive vice president, printing papers group, at Abitibi-Price. He told delegates at the *Pulp & Paper* Groundwood Papers Conference that some mills will probably be shut down. Factors affecting the viability of mills include the growing trends toward recycling and stronger environmental controls. "Mills which die over the next few years will likely do so because the grants and concessions won't be enough to fix them up and bring them into environmental compliance," Davis said.

Davis expects little or no capacity for directory or forms paper will come from expensive machine conversions. In addition, low-grade MF paper capacity will decrease by as much as 50% during the 1990s in North America. Conversely, said Davis, SC capacity will grow rapidly with two or three new publication-quality machines, but he fears a proliferation of soft-calendered smooth papers coming from newsprint conversions. Add to this the fact that European SC capacity will remain glutted for several years, and the outlook is not so strong from a sales standpoint.

Davis described several mitigating factors against the conversion of old machines:

- Soft nip calenders are expensive, and the addition of clay leads to heavy environmental expenditures, as well as technical difficulties from closing up whitewater systems.
- The grades made on converted machines will not be isolated into specialty niche markets. More likely, they will compete with those made on low-cost, efficient, commodity-type machines.
- Ongoing return on the considerable capital investments will be marginal.
- Overcapacity will persist in Europe, and it is projected for North America as well.

"The $64,000 question," said Davis, "is *how much* these factors will withstand the industry's powerful, driving force to solve facility problems.

"At this point, the mill should be allowed to die, and a new one built in its place. But old mills don't die easily, and we don't know how to kill them. The sociological consequences are too difficult for the owners, the unions, or government to handle," he said.

Market demands will draw groundwood papers further away from newsprint and more toward the qualities of fine papers. This will occur as pressure increases for recycling; currently, only one mill makes SC paper from recycled fiber. At some point, groundwood mills will have to develop the technology to use deinked old newspapers in LWC and SC papers, Davis said.

As for market segment demand, Davis expects slow growth in directory papers—about 2% to 4%/year. Forms papers should have "fair" growth of 3% to 5% annually. The MF groundwood grades will continue declining by about 2% to 5%/year. Fast growth of 8% to 10% annually is projected for "smooth papers," including SC. LWC papers also will experience good growth of about 5% to 6%/year, Davis said.

Market trends affecting the use of groundwood papers are reflected by advertising expenditures. Print's share of advertising spending has increased slightly compared with broadcast, according to Claude Giroux, vice president and marketing director for Academy-Ogilvy Communications Inc., an affiliate of Ogilvy & Mather.

Giroux told delegates at the Groundwood Papers Conference that "the paperless society did not make it past the 'blue sky' stage: 58.5% of all U.S. advertising expenditures in 1989 were in a print medium, up slightly versus 56.5% in 1980." In contrast, broadcast has held steady at about 28% or 29% share. Giroux said that print remains the most powerful way of delivering a personalized message to an increasingly segmented market of well-educated people. In terms of dollars spent, print has gained 144% since 1980 for a total of $73.9 billion in 1989.

Daily newspapers account for the biggest chunk of 1989 spending at $32.7 billion—up 121% from the beginning of the decade. Daily newspapers' share of total print expendi-

NEW AND PROPOSED NORTH AMERICAN SUPERCALENDERED CAPACITY

Company	Mill	Capacity (000 short tons)	Date
Canadian Pacific Forest Products	Trois Rivières, Que.	70	1987
Abitibi-Price	Jonquière, Que.	65	1987
Lake Superior Paper[1]	Duluth, Minn.	240	1987
St. Marys Paper	Sault Ste. Marie, Ont.	131	1988
Madison Paper	Madison, Maine	182	1988-89
Stone-Consolidated[2]	Grand'Mère, Que.	202	1990
Lake Superior Paper	Duluth, Minn.	240	n.a.
Madison Paper	Madison, Maine	n.a.	n.a.

n.a. = Not available.

1. Partly owned by Pentair Inc.
2. Grade driven by market—may be rotonews or SC.

tures has decreased from 48.9% in 1980 to 44.3% in 1989. Newspaper circulations are increasing very slowly—about 1% in 1987—and publishers face external pressures, such as consolidation among retailers and a softening in financial advertising. Over the long term, Giroux said, newspapers must fight local TV and radio for a share of retailers' growing expenditures.

Direct mail, the fastest-growing print segment, accounted for $23.2 billion in 1989—an increase of 206% since 1980. Giroux said direct mail will continue to drive the entire print category. In Canada, it has overtaken television as the No. 2 medium behind newspapers. Direct mail accounts for 31.4% of all print expenditures—up from 25.1% in 1980. Its customer base is growing and now includes packaged goods companies, such as Kimberly Clark Corp. and General Foods. This growth also pushes up demand for higher-quality, higher-impact packages. Attention-grabbing techniques include 3-D designs and holography.

Growth in spending for magazines has slowed, reaching $9.6 billion in 1989. Yet, spending grew 94% during the 1980-89 period. Magazines have lost market share, which declined from 16.4% in 1980 to 13.0% in 1989. Over half the loss was suffered by trade magazines because of increased use of direct mail. Consumer magazines have also lost share, Giroux said. Nevertheless, advertising expenditures for magazines are expected to double during the 1990s.

Yellow pages make up the smallest segment of the print market, with $8.4 billion in 1989 spending and decade-long growth of 188%. The directory publishing industry has undergone a shakeout, with many independent publishers folding or selling out to the RBOCS, but ad revenues will be boosted by better-quality paper and the fact that yellow pages represent direct marketing to "qualified" customers.

Another area of growth is catalogs. Mail order sales have increased at more than double the rate of retail sales for several years, according to Conrad Cudzewicz, advertising controller for Spiegel Inc. This growth is being spurred by increased numbers of women in the workforce as well as the maturing of the baby-boom generation, which comprises one-third of the population and wields increasing economic power. By 1995, 80% of baby-boom women will be working; when added to their other concerns of family and home, this gives them little time for conventional retail shopping.

Cudzewicz believes the print medium will remain the dominant form of advertising communication because of its convenience, as opposed to computer shopping or televised home-shopping programs.

Denis Gosselin, editor of the *Chicago Tribune Magazine*, told Groundwood Conference delegates that Sunday magazines have experienced declining revenues. The number of such weekly magazines has dropped from 58 in 1983 to 47 in 1988. Among the casualties were magazines at the *Atlanta Journal*, *Columbus* (Ohio) *Dispatch*, *Houston Post*, *Sacramento Bee*, *Dayton* (Ohio) *Daily News*, *Dallas Times Herald*, and *Denver Post*.

Free-standing advertising inserts have increased, along with multiple-sectioning and zoned editions of the parent newspapers. Many newspapers have linked up with the national Sunday magazines, *Parade* and *USA Weekend*, drawing ads from the local versions. Sunday magazines also suffered from growth in targeted consumer magazines, such as city magazines. Other competition comes from the national

CANADIAN UNCOATED GROUNDWOOD PAPER EXPORTS

(short tons)

Destination	1988*	1987	1986	1985	1984	1983	1982	1981	1980
U.K.	77,100	23,590	n.a.	n.a.	n.a.	505	n.a.	7,325	9,432
Benelux	2,507	n.a.	n.a.	n.a.	30	n.a.	n.a.	n.a.	1,549
Hong Kong	8,619	1,867	3,695	3,188	2,876	1,226	2,867	4,285	7,484
Singapore	5,153	0	n.a.	n.a.	n.a.	n.a.	2,078	3,972	2,773
Japan	57,764	132	56	10,556	10,647	9,248	n.a.	23	n.a.
Philippines	n.a.	0	n.a.	n.a.	13	n.a.	1,739	1,842	1,312
Thailand	4,422	0	n.a.	1,688	2,574	483	786	n.a.	1,595
Other Asia[1]	39,106	n.a.	n.a.	43	142	110	1,068	109	572
Australia	9,976	2,127	1,216	2,798	4,161	2,331	8,189	3,387	18,434
Colombia	6,188	0	1,351	2,244	1,922	2,752	1,571	4,087	2,101
Venezuela	30,835	11,381	n.a.	n.a.	n.a.	1,217	n.a.	981	n.a.
Other Latin America[1]	10,960	n.a.	1,348	1,150	720	1,387	1,652	794	1,070
U.S.	1,203,242	737,685	658,129	544,212	695,312	556,048	439,338	292,460	258,768
Total	1,504,181	780,400	665,862	566,473	718,637	575,307	459,288	318,265	305,090

n.a. = Not available.

* = Changed to harmonized system in 1988.

1. Not necessarily same countries each year.

Source: *Statistics Canada* (commodity class 351-49 to 1987; HS 4802.60 in 1988).

daily newspapers: *USA Today*, *National Sports*, and *Newsday*, which Gosselin said are really magazines.

Sunday magazines are no longer unique, he said. Thus, half of them are losing money and one-fourth are barely breaking even. Gosselin foresees a continuing shakeout during which local Sunday magazines will be further displaced by *USA Weekend* and *Parade*, plus local or regional syndication of certain publications.

Despite the pressure to trim costs at Sunday magazines, downsizing them to 8 ¼ x 10 ¾ did not catch on. Publishers instead are looking toward the so-called "Part 2s," which are free-standing, single-topic magazines that run concurrently with the main Sunday magazine. The *New York Times* runs about 19 per year, while the *Chicago Tribune* publishes about nine annually. A less local Part 2 is *Good Health*, which resulted from a network of the *New York Times*, *Los Angeles Times*, *Chicago Tribune*, *Boston Globe*, and *Washington Post*. All five issues of *Good Health* were printed on the same stock at the same size by the same printer. Each carried local editorial copy, but advertising was sold cooperatively, giving advertisers a choice in any combination of the five major U.S. markets.

UNCOATED GROUNDWOOD PAPERS: U.S. PRICE HISTORY

($/ton, year-end)

Year	Directory[1] (22.5-lb white)	SC-A (34-lb)	Premium roto news
1989			
2Q	$850*	$830*	$680*
1Q	850	830	680
1988			
4Q	850	830	680
3Q	780	830	680
2Q	780	780	680
1Q	750	780	652
1987			
4Q	720	740	600-620
3Q	703	710	553
2Q	670	670	517
1Q	(620)/670*	670	517*
1986			
4Q	670	710	570
3Q	670	710	540
2Q	670	780*	540
1Q	670	780*	540
1985			
4Q	670	780*	540
3Q	670	780*	540
2Q	670	780	567
1Q	670	780	580
1984	670	735	560
1983	650	645	540
1982	650	635	515/520
1981	578	n.a.	500/515
1980	535	n.a.	475
1979	480	n.a.	404
1978	420	n.a.	350/375
1977	n.a.	n.a.	330

n.a. = Not available.

* = Discounting off list price.

[1] Reflects spot market sales, not contract tonnage to regional Bell operating companies.

Sources: *Pulp & Paper Week*; *Pulp & Paper Pricebook2.*

UNCOATED GROUNDWOOD PAPER: U.S. EXPORTS AND IMPORTS

(000 short tons)

Year	Exports[1]	Imports[2]
1988	70	1,363
1987	56	1,270
1986	41	1,527
1985	37	1,387
1984	30	1,298
1983	37	920
1982	56	653
1981	120	650
1980	101	688
1979	80	695
1978	58	611
1977	54	443
1976	71	338
1975	74	84
1974	53	110
1973	29	120
1972	18	142
1971	10	156
1970	7	218

[1] Prior to 1978, Census classification was groundwood paper, printing, writing and converting, uncoated. From 1978, classification was printing and writing papers, over 10% mechanical pulp, uncoated.

[2] Prior to 1978, Census classification was uncoated book and printing paper with over 25% mechanical pulp. From 1978, classification was the same except for mechanical pulp content, which was reclassified as over 10% mechanical pulp.

Source: Bureau of the Census.

Paper:

COATED

Coated papers are traditionally divided two ways for industry statistical purposes: according to whether they are coated one side (C1S) or coated two side (C2S), and according to their pulp content. Paper with 10% or more mechanical pulp is designated coated groundwood; paper with less than 10% is coated free-sheet. Coated groundwood papers are often referred to as lightweight coated (LWC), though basis weights may actually be as high as 40 to 45 lb. In essence, a mill can classify papers as it likes, and introduction of new intermediate grades may blur distinctions even further.

Demand for C1S paper is slowly declining, although in 1988 it remained about 6% of the total coated paper market and 13% of coated free-sheet production. C1S paper is generally used for labels and other special applications. C2S papers are used for magazines, catalogs, advertising brochures and inserts, and other commercial printing.

Coated papers are further differentiated by grades ranging from superpremium, which is the most expensive and highest-quality sheet, to No. 5, which is at the bottom of the scale in terms of quality and price. Superpremium and Nos. 1 to 3 are made from chemical pulps (free-sheet). No. 4 may contain a large amount of mechanical pulp (groundwood), and No. 5, with rare exceptions, always contains a high percentage of mechanical pulp. No. 5 papers make up about 48% of the total coated paper market, and the U.S. produced about 140,000 tons of these papers in 1988. Because of the various grade divisions, mills are inclined to designate papers as they see fit. For example, some mills call a higher-quality No. 1 grade a "superpremium" and omit the No. 1 designation from their product line. Other mills may call such a paper their premium No. 1.

Each successively higher-quality grade is produced in smaller tonnages than the one before it, with the exception of No. 2. In 1988, No. 1 represented 6% of total U.S. coated paper production. Share of No. 2 was 4%, No. 3 was 16%, and No. 4 was 20%. About 47% of all No. 4 paper is coated groundwood, and the trend is toward increasing the free-sheet end of the grade. No. 5's market share has declined during the past two decades, but actual tonnage has risen substantially.

U.S. STATISTICS FOR COATED GROUNDWOOD PUBLICATION PAPERS

	1989e	1988r	1987r	1986	1985
Production,[1] 000 tons	4,335	4,160	3,782	3,478	3,410
Capacity,[2] 000 tons	4,478	4,376	4,136	3,799	3,820
Utilization rates, %	96.8	95.1	91.4	91.6	89.0
Imports, 000 tons	577	591	500	401	393
Exports, 000 tons	53	46	39	36	44
Apparent U.S. consumption					
000 tons	4,859	4,705	4,243	3,843	3,758
lb/capita	39.15	38.23	34.79	31.91	31.42
000 tons/$ billion real GNP (1982)	2.73	2.36	2.21	2.07	1.05

e = Estimate.
r = Revised.
1. *Pulp & Paper* estimates.
2. American Paper Institute capacity for coated groundwood papers; includes coated grade No. 5 and some No. 4.

Because Canada only recently expanded its presence in coated papers, comparable breakdowns are harder to come by. However, by mid-1989, coated paper accounted for 15% of total printing/writing papers production (uncoated groundwood, uncoated free-sheet, and coated). This level was down from 17% in 1988 and 16% in 1987, probably due to market conditions. Capacity will increase substantially during the next few years.

The premium coated grades—Nos. 1 and 2—generally have basis weights that range from 60 to 100 lb. Nos. 3 and 4 are offered in basis weights of 25 to 90 lb. Commercial printers are the biggest users of coated free-sheet; end uses include annual reports, catalogs, other advertising and promotional materials, and cover and interior pages of upscale magazines. In recent years, about 12% of No. 3 production went to magazine publishers, and 76% went to commercial printers.

Coated groundwood papers are commonly made in the 32-to-50-lb range (25 x 38 in. in reams of 500), although basis weights can run as low as 30 lb and as high as 70 lb. End uses include magazines, Sunday newspaper supplements, catalogs, newspaper inserts, directories, books, and flyers. Coating weight is approximately 30% of total sheet weight for LWC papers.

Differences among printing methods (letterpress, offset, and rotogravure) require that papermakers design their products for specific types of printing. Offset papers have grown rapidly in importance, and today they represent the largest portion of C2S publication papers—between 75% and 80%. Letterpress accounts for less than 10%, and gravure makes up most of the balance.

The offset printing process requires smooth surface and pick resistance. The letterpress

U.S. STATISTICS FOR COATED FREE-SHEET PUBLICATION PAPERS

	1989e	1988r	1987r	1986	1985
Production,[1] 000 tons	3,435	3,338	3,085	2,781	2,465
Capacity,[2] 000 tons	3,731	3,456	3,229	2,944	2,845
Utilization rate, %	92.0	97.0	96.0	94.5	86.6
Imports, 000 tons	124	119	114	100	103
Exports, 000 tons	64	62	57	42	39
Apparent U.S. consumption					
000 tons	3,495	3,395	3,142	2,839	2,529
lb/capita	28.16	27.59	25.76	23.58	21.12
000 tons/$ billion real GNP (1982)	1.71	1.77	1.63	0.67	0.70

e = Estimate.
r = Revised.
1. *Pulp & Paper* estimates.
2. American Paper Institute survey.

TYPICAL PROPERTIES OF COATED PUBLICATION GRADES

General characteristics	Typical use	Basestock	Coating	Brightness
No. 1: Enameled, double-coated, hand-sorted expensive base and coating; high gloss; basis weight above 70 lb	Annual reports	High-brightness chemical pulp; heavily filled	High in TiO_2; high gloss enameled; synthetics	82-88
No. 2: Double-coated, expensive base and coating	Expensive advertising	High-brightness chemical pulp; filled (clay)	High in TiO_2; some clay; synthetics	78-82
No. 3: Single- or double-coated, lower-quality basesheet	Advertising	Chemical pulp; minor amounts of groundwood	Mostly clay, some TiO_2 less expensive	76-82
No. 4: Lower cost, lower brightness	Magazine	Groundwood and chemical pulp; some clay filler	Less expensive; coating—clay and TiO_2	72-78
No. 5: Lower basis weight, high groundwood content	Directories, catalogs, magazines	Mostly groundwood or TMP, chemical pulp for runability	Variable, some contain synthetics	68-72

process is slightly less demanding in terms of paper-surface properties, but it generally needs heavier basis weights because of strikethrough in low basis-weight papers. Gravure printing is often used for long press runs that require paper with a smooth surface and controlled ink receptivity.

A large mill that is installing a new machine or substantially rebuilding existing equipment typically opts for an on-machine coater. A smaller, older mill often finds it easier to use an off-machine coater that can simply be shut down when the mill needs to make uncoated paper. During the coating process, one station applies coating to one side, although the same station can be used to apply coating simultaneously to both sides. Mills may also have coating equipment that applies two coats on the same side, or a precoat may be applied to smooth out surface roughness. These processes are separate from the coating that a printer may add during or after the printing run. This adds an even glossier surface to the paper (e.g., magazine covers), and it can be done inline (UV) or later, which is more expensive.

Coating solutions consist of pigments (kaolin clay, titanium dioxide, or calcium carbonate), binders, and additives to control viscosity and other rheological properties. Delaminated clay is increasingly being used, especially in LWC papers. These coatings provide better runability when combined with conventional kaolins.

Water comprises as much as 50% of a coating formulation, and the excess must be dried quickly and efficiently by through-air drying, drum drying, and infrared drying. Once the excess water is removed, the coated sheet is supercalendered if a glossy finish is desired, and it may be supercalendered through the nip of many rolls to further develop the surface gloss. If a high-gloss finish is required, as it is with an enameled sheet, a gloss calender is used. Dull-finish and matte-finish papers are made by curtailing the use of supercalenders. Dull-finish paper gets little or no pressure from the supercalender. Matte-finish paper goes through a supercalender with one stack that has been sandblasted or engraved to imprint the matte appearance. Matte-finish paper gives a gloss test reading of 20 or less, while dull-finish paper can reach 45 or 55 on the gloss scale. Glossy finish is higher. Probably about 90% of C2S paper is glossy, about 10% matte, 3% dull, and a small amount embossed.

Between 85% and 90% of coated paper is shipped in rolls rather than sheets.

INDUSTRY STRUCTURE

About 30 companies claim most of the industry's capacity, and more than 60% of North American coated paper capacity is controlled by the top five companies. Major coated free-sheet producers are Scott Paper Co., Westvaco Corp., Mead Corp., Potlatch Corp., and Simpson Paper Co. The five largest coated groundwood producers are Champion International Corp., International Paper Co., Consolidated Papers Inc., Repap Enterprises Inc., and Bowater Inc.

Producers continue to add capacity, with about one million tpy started up from 1987 to 1989. In 1988-89, major new capacity was brought on by Midtec Paper Corp. (Repap Enterprises) at Kimberly, Wis.; Blandin Paper Co. at Grand Rapids, Minn.; and Repap at New Castle, N.B., which started up a swing machine in late 1989 to make both coated groundwood and coated free-sheet. In 1990-91, large new tonnages will be brought online by Westvaco at Wickliffe, Ky. (a conversion); Champion International at Quinnesec, Mich.; Scott Paper's S.D. Warren Div. at Somerset, Maine; and Consolidated Papers at Wisconsin Rapids, Wis. In addition, Boise Cascade Corp. will install a 318,000-tpy coated groundwood machine at Rumford, Maine, for startup in 1993.

Canadian coated free-sheet capacity in 1988 was slightly above 140,000 short tpy. It climbed to 160,000 tpy in 1989, 182,000 tpy in 1990, and almost 200,000 tpy in 1991, according to the Canadian Pulp & Paper Assn. Coated

U.S. COATED PAPER PRODUCTION

(000 short tons)

Year	Total coated[1]	Coated one side[2]	Coated two side[2] Total	Coated two side[2] Nos. 1-4	Coated two side[2] No. 5
1989e	7,498	412	7,086	3,540	3,546
1988	7,360	419	6,941	3,325	3,616
1987	6,859	422	6,437	3,117	3,320
1986	6,260	385	5,875	2,755	3,120
1985	5,860	360	5,500	2,520	2,980
1984	6,249	390	5,860	2,670	3,190
1983	5,675	390	5,285	2,320	2,965
1982	4,970	365	4,605	2,025	2,580
1981	4,880	395	4,485	2,035	2,450
1980	4,615	375	4,240	1,840	2,400
1979	4,642	410	4,230	2,080	2,150
1978	4,593	440	4,155	2,000	2,155
1977	4,274	415	3,860	1,640	2,220
1976	3,890	410	3,480	1,490	1,990
1975	3,076	330	2,740	1,120	1,620
1974	3,739	410	3,330	1,650	1,680
1973	3,757	435	3,320	1,430	1,890
1972	3,455	400	3,055	1,040	2,015
1971	3,165	360	2,805	905	1,900

e = Estimate.

[1] Shipments for both one- and two-side coated papers.

[2] *Pulp & Paper* estimate. May not add to "Total coated" due to rounding.

groundwood capacity in Canada is much more substantial. It was 380,000 short tpy in 1988, 430,000 tpy in 1989, over 570,000 tpy in 1990, and 612,000 tpy in 1991.

U.S. imports of Canadian coated grades were almost 232,000 tons in 1988—up from about 200,000 tons in 1987. Nearly all of the imported tonnage was coated groundwood.

TRENDS IN LWC PUBLICATION GRADES

Paper is usually considered LWC if it is under 40-lb basis weight, although some companies include 45-lb in the category. Most of the LWC paper produced in North America is used in consumer and trade magazines; therefore, demand for LWC paper follows trends in magazines. For example, the coated paper glut of 1986-87 was partially attributable to requests from publishers earlier in the decade for added capacity. But declines in advertising pages in 1985, 1986, and early 1987 actually caused a slowdown in demand from publishers. Coated groundwood accounts for 75% of all paper consumed by domestic magazines. Magazine publishers and printers purchase about 60% of the total coated groundwood paper manufactured in North America.

Overall demand for print advertising is on the rise, and magazines will be major beneficiaries of that trend, growing slightly less than direct mail. "The Paper Outlook" of the Magazine Publishers of America (MPA) surveyed 61 publishing companies and found that respondents expected to increase paper consumption in 1989 by 4.4% over the 1988 level. Publishers predict paper usage will advance by 7.6% in 1990.

Publishers also expect to continue moving away from heavier basis weights. In 1988, 34-lb paper accounted for about 33.3% of all paper used. By 1990, its share is expected to rise to 35.4%. Meanwhile, use of 40-lb paper is forecast to drop from 22.5% in 1988 to 20.6% in 1990, according to MPA.

The drop in basis weights is spurred primarily by rising postal rates, which have led some magazines to consider alternate delivery methods. *Time* magazine is involved in alternate delivery "in a big way," according to David Refkin, assistant director of paper purchasing for Time Inc. At the *Pulp & Paper* Fourth Groundwood Papers Conference in October 1989, Refkin said, "We are currently delivering *Time*, *People*, *Sports Illustrated*, and *Fortune* magazines in three zip codes in Atlanta. We've had the No. 3 person at the post office sit on the truck with us at three o'clock in the morning and watch what we do, which is deliver the magazines in the driveways or near the mailboxes of suburban homeowners. The Post Office has even filmed what we do. We need to instill a sense of competition in the Post Office, and until that happens, the Post Office, we don't feel, will respond." Nevertheless, alternate delivery is expensive, and even the next slated postal hike will not make it attractive on a widespread basis.

Average postal rates for second-class mail (e.g., magazines) rose a cumulative 229% between 1970 and 1983. They dropped 7.6% in 1984 and re-

NEW NORTH AMERICAN COATED PAPER CAPACITY THROUGH 1993

Company, U.S.	Location	Annual short tons	Startup
Westvaco	Luke, Md.	90,000	1986-88
Dunn Paper[1]	Port Huron, Mich.	no increase	1987
Mead	Escanaba, Mich.	no increase	1987
Simpson Paper	Pasadena, Texas	n.a.	1987-90
Fraser	Madawaska, Maine	52,000	1988
Midtec Paper/Repap Enterprises	Kimberly, Wis.	200,000	1988
S.D. Warren/Scott Paper	Muskegon, Mich.	n.a.	1988
S.D. Warren/Scott Paper	Westbrook, Maine	n.a.	1988
Blandin Paper	Grand Rapids, Minn.	221,000 net	1989
Potlatch	Cloquet, Minn.	no increase	1989
Champion International	Bucksport, Maine	n.a.	1989
Wausau Paper Mills	Rhinelander, Wis.	25,000	1989
Champion International	Quinnesec, Mich.	265,000	1990
Westvaco	Wickliffe, Ky.	100,000	1990
S.D. Warren/Scott Paper	Skowhegan, Maine	215,000	1990
Weyerhaeuser	Columbus, Miss.	n.a.	n.a.
International Paper	Various	200,000	1988-92
Consolidated Papers	Wisconsin Rapids, Wis.	200,000	1991
Boise Cascade	Rumford, Maine	318,000	1993
Blandin Paper	Grand Rapids, Minn.	220,000	Under study
Great Northern Nekoosa/ MD Papier	Millinocket, Maine	n.a.	Under study
Bowater	Calhoun, Tenn.	240,000	Under study
Fraser	Madawaska, Maine	n.a.	Under study
James River	St. Francisville, La.	n.a.	Under study

Company, Canada	Location	Annual metric tons	Startup
Repap Enterprises	Newcastle, N.B.	200,000-260,000	1989
Island Paper Mills	New Westminster, B.C.	75,000	1990
Repap Enterprises	Prince Rupert, B.C.	200,000	n.a.
Makin Pulp & Paper	Britannia Beach, B.C.	140,000	n.a.

n.a. = Not available.
1. Div. of James River Corp.

Sources: *Pulp & Paper Week*; *Pulp & Paper Project Report*.

mained level until 1985 when the cost of bulk mail rose by about 13.6%. In April 1988, the U.S. Postal Service approved rate increases of 25% on third-class mail and 18% on second-class items. Fourth class (parcel post) increased 15%, and first class went up about 14%. Bulk mail advertising (i.e., junk mail) and catalogs are mailed third class.

Supercalendered (sc) paper became an acceptable competitor in the early 1980s during a paper shortage. K-Mart Corp., Sears Roebuck & Co., and other retailers used rotonews and SC papers more liberally in their catalogs and advertising. In late 1986 and 1987, customers produced better-quality literature for the same cost, or they saved even more money by staying with the lower-quality grades. Still others moved from coated groundwoods to No. 4 coated free-sheet grades when those prices weakened in 1987. The situation changed in mid-1987, and shortages again caused price increases and grade switching even though competing grades were also scarce. When prices fell in late 1988 and throughout much of 1989, deals on coated paper were more readily available.

New papermaking technology has enhanced runability and printing characteristics such as ink holdout and ink gloss, which are more important to publishers than opacity. Thus, the mechanical integrity of the sheet (i.e., flawlessness) is more important.

In order to lower basis weights below 36 lb, mills must reduce the weight of both the basestock and the coating. Different coating mixtures and new lightweight chemical compositions allow some mills to make the reductions in coat weight—going to a 6-lb coating formulation, for example, from a 10-lb or higher formulation. Other mills reduce the weight of the basestock by a greater percentage. Some mills can use a lighter-weight basesheet than other mills. Surface smoothness is the deciding factor.

Strength can be gained with the addition of kraft fiber, which helps reduce breaks in web printing. Groundwood fiber reduces cost, maintains opacity and surface smoothness, and supplies much of the sheet's fiber content.

Thermomechanical pulp (TMP) and chemi-thermomechanical pulp (CTMP) have received wide industry attention as alternatives to stone groundwood pulp. The TMP process produces fibers that are better separated than groundwood pulp fibers, and they have the added benefit of retaining much of their original length. Thus, TMP fibers hold together better, adding strength to the finished paper. CTMP has a tensile strength that is about equal to chemimechanical pulp and higher than TMP, plus it has a higher tear factor. CTMP paper normally has a lighter color than TMP.

Various industry observers believe that International Paper chose a variation of CTMP for its new coated groundwood mill at Pine Bluff, Ark. That mill uses "chemically enhanced groundwood" for its basesheet, although the process reportedly encountered some initial production problems. If papermakers had their way, most of them would use titanium dioxide as a coating material, especially for

U.S. COATED PAPER CAPACITY

(000 short tons)

Year	Coated free-sheet	Change (%)	Coated groundwood*	Change (%)
1991p	4,300	7.0%	4,650	-0.2%
1990p	4,020	7.7	4,659	4.0
1989p	3,731	8.0	4,478	2.3
1988	3,456	7.0	4,376	5.8
1987	3,229	9.7	4,136	8.9
1986	2,944	3.5	3,799	-0.5
1985	2,845	1.9	3,820	1.4
1984	2,791	12.9	3,766	6.9
1983	2,473	8.9	3,522	6.3
1982	2,271	1.2	3,312	8.7
1981	2,225	0.2	3,047	10.3
1980	2,222	0.4	2,762	10.1
1979	2,214	5.6	2,511	2.5
1978	2,096	5.4	2,450	1.7
1977	1,989	4.5	2,408	12.2
1976	1,903	-1.5	2,299	8.1
1975	1,938	—	2,127	-4.8
1974			4,075	0.7
1973			4,045	4.6
1972			3,866	0.2
1971			3,778	0.2
1970			3,700	-0.1
1969			3,732	—

* Includes all coated paper capacity until 1975.
p = Preliminary.

Source: American Paper Institute.

MAJOR U.S. COATED FREE-SHEET PRODUCERS

(1989 estimated capacities)

		Annual capacity (000 tons)	Capacity share (%)
1.	Scott Paper[1]	900	24.1%
2.	Westvaco	530	14.2
3.	Mead	415	11.1
4.	Potlatch	311	8.3
5.	Simpson Paper[2]	290	7.8
6.	Champion International[2]	265	7.1
7.	Consolidated Papers[2]	255	6.8
8.	Midtec[3]	200	5.4
9.	International Paper	175e	4.7
10.	James River	148	4.0

U.S. capacity (1989): 3.731 million tons
Capacity share of top five companies: 65.6%
Capacity share of top ten companies: 93.5%

e = Estimate.
[1] S.D. Warren Div.
[2] *Pulp & Paper* estimate.
[3] Div. of Repap Enterprises.

LWC, because of its superior opacity. But TiO_2 pricing is volatile, and it has been running high in recent years. Kaolin clays remain the most widely used coating by volume—about four million tons used in 1987 compared with 200,000 tons of titanium dioxide. When titanium dioxide is used, such as with delaminated grades, the balance of coating material content is specialized clay: calcium carbonate, hydrated alumina, plastic pigment, talc, and zinc oxide.

A massive amount of CTMP capacity is already online or scheduled for startup in North America. Producers will try to convince customers to add it to kraft pulp for reduced costs, or add it to mechanical pulp for increased brightness and strength.

OUTLOOK FOR COATED PAPERS

Nos. 1, 2, and 3 grades will experience strong growth in the near term. Producers such as Consolidated Papers, Potlatch, and Westvaco have already introduced new premium or superpremium No. 1 grades that possess better reproduction qualities and have higher prices than the established No. 1 papers. European producers have also entered the market; they currently supply about 8% of total U.S. demand for Nos. 1, 2, and the superpremium grades.

No. 2 will increase its share of the coated market to nearly 5%. No. 3 will grow 5.7% annually because it is produced mostly at integrated kraft mills, which have distinct cost advantages. For a minor price increase, end users can upgrade from No. 4 grades, which are normally produced at mills that must purchase kraft pulp. Demand for No. 4 free-sheet will increase faster than demand for No. 4 groundwood. CIS paper, which is used primarily for labels, is forecast to grow only 0.7% annually.

Prices for coated free-sheet rose in July 1988. Historical pricing trends ($/short ton, average price for year) are as follows for 70-lb No. 1 sheets: 1984, $1,321; 1985, $1,375; 1986, $1,350; 1987, $1,410; 1988, $1,509. The following are historical prices for No. 3 rolls: 1984, $919; 1985, $980; 1986, $945; 1987, $980; 1988, $1,115.

Rising prices in 1987-88 encouraged inventory building, especially by merchants and commercial printers, creating tight markets for most of 1988. Demand slackened at the end of 1988, and prices fell as much as $60 to $80/ton in 1989. Even though some analysts foresee a recession, most insist the paper industry will do well again in 1989, with some dropoff possible in 1990.

Strong demand and tight markets caused prices for coat-

MAJOR NORTH AMERICAN COATED GROUNDWOOD PRODUCERS

		Annual capacity (000 tons)	Capacity share (%)
1.	Champion International	689	14.3%
2.	International Paper[1]	645	13.4
3.	Consolidated Papers[1]	600	12.4
4.	Repap Enterprises	450	9.3
5.	Bowater	340	7.0
6.	Blandin Paper	311	6.4
7.	Mead	300	6.2
8.	Boise Cascade	285	5.9
9.	James River	234	4.8
10.	Pentair[2]	220	4.6

North American capacity (1989): 4.868 million tons
(U.S. 4.478 million, Canada 390,000).
Capacity share of top five companies: 56.4%
Capacity share of top ten companies: 84.3%

[1] *Pulp & Paper* estimate.
[2] Niagara, Wis.

TRENDS IN MAGAZINE-GRADE PAPER BASIS WEIGHTS

(% of total usage)

Basis weight	1988	1989e	1990e
32 lb and below	3.3%	3.5%	3.9%
33 lb	0.1	0.1	0.1
34 lb	33.3	33.7	35.4
35 lb	0.2	0.2	0.2
36 lb	11.9	11.2	10.0
38 lb	5.7	5.3	5.2
40 lb	22.5	21.1	20.6
45 lb	3.6	6.3	6.2
50 lb	8.9	8.3	8.2
55 lb	0.4	0.4	0.4
60 lb and above	10.1	9.9	9.8

e = Estimate.

Source: Magazine Publishers of America, "The Paper Outlook."

TRENDS IN PAPER USE BY MAGAZINE PUBLISHERS

(000 tons)

Grade	1988	1989e
Coated groundwood	1,088	1,177
Coated free-sheet	182	236
Uncoated groundwood	223	255
Uncoated free-sheet	10	12
Imported coated groundwood	48	57
Imported uncoated groundwood	7	14
Total[1]	1,558	1,751

e = Estimate.
[1] May not total due to rounding.

Source: Magazine Publishers of America, "The Paper Outlook."

ed groundwood papers to rise in 1988, as they did in 1987, but discounting was reported by the end of the year. A slight softening in demand caused by inventory "work-downs" led mills to put off a 1989 price increase.

Historical pricing trends ($/short ton, year-end) for 34-lb No. 5 roto paper are as follows: 1981, $760; 1982, $760; 1983, $782; 1984, $890; 1985, $931; 1986, $860; 1987, $890; 1988, $990; first-quarter 1989, $990.

Jeanne Carroll, an analyst with Morgan Stanley & Co. Inc., told delegates at *Pulp & Paper*'s Groundwood Papers Conference that coated groundwood paper capacity will advance about 4.0% in 1990, 1.3% in 1991, and 1.0% in 1992. She said consumption will grow about 4.0% in 1990, 4.1% in 1991, and 5.5% in 1992, leading to operating rates of 90.3%, 92.1%, and 95.6%, respectively.

North American mills may face stiffer competition from producers in Europe because of excess capacity there. In fact, an abundance of new capacity in newsprint and uncoated and coated mechanical paper grades is likely to cause operating rates at European mills to drop below 80% during the next few years, according to the European Paper Institute's (EPI) Paper Capacity Report for Woodcontaining Publication Papers in Reels. The report's summary indicates that from 1988 to 1993, net production capacity of these grades will increase by about 4 million metric tons—a 28% overall growth rate. This does not include planned projects that are awaiting final approval, which could add another 1.5 million tons. Half of the total capacity increase will be in coated mechanical grades, including the lightly pigmented papers or intermediate grades.

Strong economic growth in Europe and better-than-expected imports to the U.S. helped push demand for publication paper grades higher than previously forecast, EPI said. However, the outlook for growth in the next five years "is less robust than in the recent past." This is because of increasing inflation, higher interest rates, and signs of softness in the U.S. economy.

"Based on average economic growth of about 2.5%/year and continued growth in exports, deliveries of newsprint are expected to increase at 2%/year, sc magazine at 1%, coated mechanical reels at 5.5%, and other uncoated at 5%/year for the next five years," the report said.

Based on EPI projections for decided capacity additions and deliveries, the coated mechanical grades are likely to be hit hardest, with operating rates dipping to 84.1% in 1990, 81.2% in 1991, and 81.8% in 1992. The utilization rate was an estimated 96.3% in 1988 and 91.4% in 1989.

EPI estimated that coated mechanical capacity will rise from 4.044 million metric tpy in 1988 to 6.178 million tpy in 1993. That figure does not include "planned" projects that are awaiting final approval, which could add more than 400,000 tons to the total.

sc, coated groundwood's major competitor, is in strong demand, but capacity additions are not on par with coated.

U.S. PRICES FOR COATED PUBLICATION PAPER

($/short ton)

Year	No. 1 70-lb sheets	No. 3 60-lb rolls	No. 4 50-lb rolls	No. 5 34-lb roto rolls	No. 5 40-lb rolls
1989					
2Q	$1,610-1,640	$1,270	$(920)/940	$(950)/990	$(840)/880
1Q	1,560-1,600	1,220	940-950	990-1,000	880-900
1988					
4Q	1,560-1,600	1,220	940-950	990-1,000	880-900
3Q	1,560-1,600	1,120	940-950	990-1,000	880-890
2Q	1,450	1,060	890	940	830/840
1Q	1,450	1,060	890	940	830
1987					
4Q	1,440-1,460	1060	840	890	790-800
3Q	(1,400)/1,415	1022	820	847	740
2Q	(1,390)/1,415	(945)/1,020	(740)/760	(760)/787	(640)/680
1Q	1,415*	(945)/1,020	(740)/760	(760)/787	(640)/680
1986					
4Q	1,375	980	760	860*	745
3Q	1,375	980	807	860*	(765)
2Q	1,375	980	880*	888*	798*
1Q	1,375	980	860*	902*	813*
1985	1,375	980	880	931	842
1984	1,318	921	777	860	818
1983	1,250	830	661	782	n.a.
1982	1,200	798	690	760	n.a.
1981	1,130	798	n.a.	760	n.a.
1980	1,038	750	n.a.	735	n.a.
1979	970	690	n.a.	671	n.a.
1978	893	621	n.a.	573/590	n.a.
1977	n.a.	600	n.a.	520/545	n.a.
1976	n.a.	540	n.a.	460	n.a.
1975	n.a.	486	n.a.	399	n.a.
1974	n.a.	475	n.a.	400	n.a.
1973	n.a.	n.a.	n.a.	285	n.a.

n.a. = Not available.
* = Discounting off list price reported.

Sources: *Pulp & Paper Week*; *Pulp & Paper Pricebook2*.

Thus, operating rates are likely to be high relative to coated and newsprint. In fact, sc mills are expected to post operating rates of 95% in 1989, dropping only to 87.3% in 1993.

COATED PAPER SHIPMENTS TO MAGAZINE PUBLISHERS

(000 short tons)

	Coated two side paper			All	Coated
Year	Total	Nos. 1-4	No. 5	grades[1]	imports[2]
1988	3,000	1,107	1,893	3,000	782
1987r	2,420	622	1,798	2,903	675
1986	2,428	527	1,901	2,432	501
1985	2,275	448	1,827	2,299	496
1984	2,397	498	1,899	2,428	428
1983	2,290	470	1,820	2,450	162
1982	2,010	425	1,585	2,130	69
1981	2,009	408	1,601	2,185	36
1980	1,969	405	1,564	2,125	115
1979	1,838	400	1,438	2,017	189
1978	1,902	365	1,537	2,054	214

1. Includes coated one side.
2. Includes non-magazine shipments.
r = Revised.

Source: *Pulp & Paper* estimates.

sc capacity will rise from approximately 3.021 million metric tpy in 1988 to 3.310 million tpy in 1993, according to EPI. Certain projects could add another 300,000 tpy if they are confirmed.

Coated paper consumption was over 8 million tons in 1988. After dropping slightly in 1989, it began climbing again and was expected to reach about 9 million tons in 1991 and 10 million tons in 1994, according to First Manhattan Co. Annual growth will be about 4.5%, and capacity utilization will fall below 90% in 1990-91. First Manhattan predicted that consumption by magazine publishers will slow to about 3%/year, but use of special insert pages will increase and paper quality will be upgraded.

Consumption by catalog publishers will stabilize at slightly higher than 5%/year. Targeted mailings will help reduce waste, and publishers are cutting costs through better coordination of paper purchasing and scheduling. Conrad Cudzewicz, advertising controller at Spiegel Publishing Co., uses a software program that works as an adjunct to Lotus 1-2-3 or Microsoft Excel spreadsheets. The software, called "What's Best!," has helped Spiegel with its catalog paper scheduling and purchasing, according to Cudzewicz.

"Catalog paper procurement at Spiegel currently exceeds $45 million annually," he explained. Half of Spiegel's catalog publishing budget is for paper and postage. Spiegel uses the program to determine the most cost-effective ways to schedule paper, Cudzewicz said. In trial runs, What's Best! developed a model that would save Spiegel over $250,000 on paper costs, if all recommendations are followed.

PAPER SHIPMENTS TO COMMERCIAL PRINTERS

(000 short tons)

	Coated two side paper			Uncoated	Uncoated	
Year	Total	Nos. 1-4	No. 5	free-sheet	groundwood	Total
1988	3,000	2,256	744	2,857	306	6,163
1987	2,842	2,140	702	2,735	177	5,754
1986	2,469	1,900	569	2,570	202	5,241
1985	2,240	1,760	480	2,430	250	4,920
1984	2,400	1,830	570	2,350	280	5,030
1983	2,075	1,535	540	2,165	245	4,485
1981	1,720	1,300	420	1,950	175	3,845
1980	1,605	1,200	405	2,000	220	3,825

Source: *Pulp & Paper* estimates

U.S. COATED PAPER EXPORT/IMPORT BALANCE

(000 short tons)

Year	Exports[1]	Imports[2]
1988	97	789
1987r	101	675
1986	78	501
1985	82	496
1984	86	428
1983	79	162
1982	81	69
1981	89	39
1980	92	115
1979	74	189
1978	74	214
1977	99	113[3]
1976	107	—
1975	123	—
1974	99	—
1973	80	—
1972	76	—
1971	76	—
1970	75	—
1969	70	—

r = Revised.

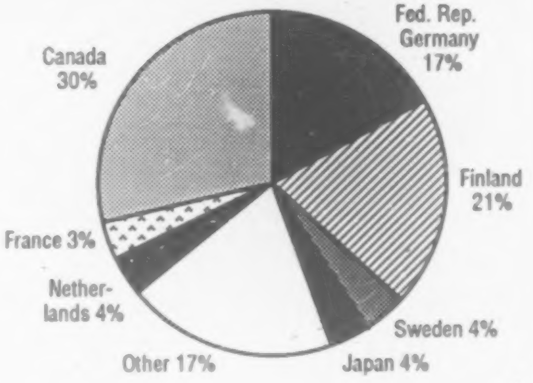
[1] Clay-coated printing/writing paper.

[2] Coated and impregnated printing papers.

[3] In previous years, coated paper imports were reported under another category.

Source: Bureau of the Census.

U.S. COATED PAPER IMPORTS, 1988



Total 1988 coated paper imports: 781,647 tons.

Source: Dept of Commerce.

Paper:

UNCOATED FREE-SHEET

Uncoated free-sheet papers have the broadest range of end uses, and they account for the most tonnage among printing/writing grades. Their end uses include personal and business stationery and envelopes, carbonless basestock for business forms, book paper, reprographic and other business papers, basestock for thermal paper, and some commercial printing.

Regardless of their end use, uncoated papers are made primarily from chemical pulps (sulfate, sulfite, soda, cotton linters, or vegetable fiber). The exception is cotton-content paper, which has some connection to uncoated free-sheet but is discussed in another chapter. Very few uncoated free-sheet papers contain any mechanical pulp; nevertheless, paper with up to 10% mechanical pulp is classified as uncoated free-sheet. That could change with the introduction of new furnishes, such as chemi-thermomechanical (CTMP) pulps, which can be combined with kraft pulp to reduce the cost of manufacture while providing a better grade of paper than stone groundwood or other mechanical pulps.

Uncoated free-sheet papers are divided into four subgroupings based on end use: publishing, commercial printing, office/business, and writing. Another smaller subgrouping includes products such as cigarette papers and carbonizing tissue.

In terms of tonnage, offset paper is currently the largest group of uncoated free-sheet papers in the U.S. market. However, office copy papers are catching up due to advances in copier and computer printer technology. Offset represented approximately 26% of all shipments in 1988, as did bond, mimeographic, duplicating, and xerographic papers. Compared with their 1987 levels, offset and copy papers increased as a percentage of the total uncoated market. Forms bond declined slightly to 19%, while envelope stayed at 11%, tablet at 4%, and miscellaneous printing/writing papers at 14%.

Most of the uncoated free-sheet paper consumed in the U.S. is produced at mills in the Northeast and upper Midwest, although capacity in the South has grown strongly during the last 20 years. Capacity has also increased in Canada, where four new uncoated free-sheet machines have come online since 1987.

U.S. STATISTICS FOR UNCOATED PRINTING/WRITING PAPERS*

	1989e	1988	1987	1986	1985
Production,[1] 000 tons	11,824	11,356	10,977	10,410	9,750
Capacity, 000 tons	12,352	11,897	11,493	11,023	10,515
Utilization rate, %	95.7	95.5	95.5	94.4	92.7
Imports, 000 tons	640	576	417	454	365
Exports, 000 tons	80	83	68	50	65
Apparent U.S. consumption					
000 tons	12,384	11,849	11,326	11,326	10,050
lb/capita	100.0	96.29	92.1	89.80	83.93
000 tons/$ billion real GNP (1982)	6.06	5.93	5.89	3.05	2.79

* All tons are short tons.
e = Estimate.
1. American Paper Institute data for shipments.

Source: *Pulp & Paper.*

In the five years from 1987 to 1991, capacity in the South is expected to grow about 19%—slower than in the past. The region's capacity will account for 43% of U.S. free-sheet capacity in 1990—up from 41% in 1987. On the other hand, the share of Northeast and Midwest capacity will decline from 48% in 1987 to 45% in 1991. Total capacity in these two regions will nevertheless increase about 6% over the 1987-91 period.

Many of the major projects coming online from 1987 to 1993 are in the South and Midwest, as well as in Canada. New capacity onstream by the end of 1989: Georgia-Pacific Corp., 290,000-tpy machine at Port Hudson, La. (1988); Champion International Corp., 260,000-tpy (1987) and 115,000-tpy (1989) conversions from unbleached kraft paper at Pensacola, Fla.; Domtar Inc., two 160,000-tpy machines at Windsor, Que. (1987 and 1989); Weyerhaeuser Canada Ltd., 217,000-tpy machine at Prince Albert, Sask. (1988); and Canadian Pacific Forest Products Ltd., 175,000-tpy machine at Dryden, Ont. (1989).

Other machines scheduled: Boise Cascade Corp., 300,000-tpy machine at International Falls, Minn. (late 1990 or 1991); Willamette Industries Inc., 255,000-tpy machine at Bennettsville, S.C. (1990); Great Northern Nekoosa Corp., 325,000-tpy machine at Ashdown, Ark.; and Union Camp Corp., 240,000-tpy machine at Eastover, S.C. (1991).

U.S. mills are building larger machines, such as the massive units being installed by Boise Cascade at International Falls and Great Northern Nekoosa at Ashdown. The number of machines producing over 125,000 tpy rose from 7.5% of total industry capacity in 1975 to 34% in 1987. Units of 75,000 tpy and below fell from 72.5% of industry capacity in 1975 to 43% in 1987.

Mills are also following the trend toward integration; i.e., having pulp capacity onsite instead of purchasing it. Many mills are building pulp facilities with enough capacity to supply more than the current paper machine project. In 1987, about 76% of all U.S. paper mills were integrated—up from 64.8% in 1976, according to data from the American Paper Institute.

Nonintegrated mills protect themselves from the volatility of market pulp prices by buying deinked pulp, pulp substitutes (white shavings, etc.), or cheaper pulps such as CTMP. The price of pulp (literally, the price of being nonintegrated) can have a dramatic effect on these mills. The cost of pulp represented only 33.9% of selling price in 1970, whereas in 1980 it rose to 56.0% in the U.S. The situation improved in early 1982, when hardwood pulp was available at deep discounts and the list price for pulp was unchanged from 18 months earlier. Pulp represented only 49.7% of the paper grade's selling price, assuming no pulp discount. The percentage was lower if discounts were applied. The pulp cost advantage of an integrated mill—$100 in 1980—probably declined as the pulp market slid.

In mid-1984, pulp prices began rising again, and uncoated free-sheet was plagued by continued discounting, especially in offset grades. The cost of pulp climbed back up to 53.5% of the paper grade's selling price. The ratio of sell-

UNCOATED FREE-SHEET PAPERS CLASSIFIED BY END-USE

- Printing/publication
  - Offset (book)[1]
  - Lightweight printing[1]
  - Envelope[1]
  - Tablet[1]
  - Cover & text[1]
- Writing
  - Bond
  - Cotton fiber[2]
- Bristols[2]
- Business
  - Forms bond[1]
  - Copy & reprographic[1]
  - Carbonless[1]
  - Mimeograph[1]
  - Duplicating[1]
  - Other
- Thin papers
  - Carbonizing
  - Cigarette
  - Condenser

1. Conforms to American Paper Institute classification of free-sheet.
2. This grade discussed in separate section.

U.S. PRODUCTION AND CAPACITY OF UNCOATED FREE-SHEET PAPERS*

(000 short tons)

Year	Production[1]	Change (%)	Capacity[2]	Change (%)
1991e	n.a.	n.a.	13,180	3.6%
1990e	n.a.	n.a.	12,721	3.0
1989e	11,824	4.1%	12,352	3.8
1988	11,356	3.5	11,897	3.5
1987	10,977	5.4	11,493	4.3
1986	10,410	7.4	11,023	4.8
1985	9,690	5.9	10,515	4.5
1984	9,152	4.9	10,058	7.5
1983	8,725	11.7	9,354	3.5
1982	7,809	-0.1	9,039	2.4
1981	7,867	-0.1	8,828	2.1
1980	7,984	4.6	8,645	6.8
1979	7,655	6.3	8,095	3.1
1978	7,198	2.3	7,847	5.1
1977	7,036	9.4	7,465	2.0
1976	6,430	13.9	7,319	1.9
1975	5,644	-18.6	7,180	1.9
1974	6,934	0.0	7,046	7.7
1973	6,933	9.4	6,541	5.5
1972	6,339	18.5	6,198	7.2
1971	5,349	3.3	5,780	1.3
1970	5,177	-0.8	5,702	0.3
1969	5,222	—	5,681	—
Average 1970-87		4.6%		4.0%

e = Estimate.
n.a. = Not available.
* Excluding cotton fiber, bristol, and thin paper.
1. Source: Bureau of the Census.
2. Source: American Paper Institute.

ing prices dropped back down in 1985, but it began another climb following strong pulp price increases in late 1986, 1987, 1988, and early 1989.

Nonintegrated mills tend to have higher fuel costs because they do not generate wastewood to supply biomass boilers, nor do they produce byproduct fuel from kraft liquor. Their biggest advantage is lower transportation costs because of their proximity to major markets in the North.

Mills that produce commodity-type grades such as offset paper, forms bond, and reprographic paper are using twin-wire or large fourdrinier paper machines. Southern mills use a blend of hardwood and softwood pulps. Hardwood fibers provide desired bulk and printing characteristics, and softwood fibers offer strength properties for improved paper machine and printing press runability.

More machines are being converted to alkaline papermaking, and many new installations are based on the alkaline process. These include all of International Paper Co.'s uncoated free-sheet mills (including Hammermill Papers), the Weyerhaeuser Canada machine in Saskatchewan, Domtar's two machines in Quebec, and Willamette's machine in South Carolina.

Interest in the alkaline process is due primarily to rising costs for fiber and fillers such as titanium oxide and calcine clay. Alkaline sheets are also stronger than acid-based papers, and the use of precipitated calcium carbonate (PCC) helps cut down fiber use.

A strong selling point to some buyers, especially librarians, is the permanence of alkaline book papers compared with acid-based stocks. The American Library Assn. Council and the National Information Standards Organization are urging publishers to print books with alkaline-based papers. Both groups worry about deterioration of library collections, according to a published report.

Essentially all mills making alkaline paper use PCC produced onsite at satellite plants owned and operated by Pfizer Inc. D.R. "Randy" Harrison, manager of market development at Pfizer, told delegates to *Pulp & Paper*'s first White Papers & Automation Conference that alkaline paper represented 22% of uncoated free-sheet capacity in 1988. He expected the figure to rise to 66% of installed capacity by 1990. That translates to about 50 mills already converted or in the process of converting, according to William C. Sellers, manager of business planning for Hammermill Papers, who also spoke at the conference.

Sellers said that alkaline paper offers excellent optical and physical properties, higher natural brightness, permanence, bulk improvement, greater stiffness and overall strength, and better printability—all for lower processing costs. He added that alkaline paper can be recycled within the mill operation without significant loss of strength.

Production of uncoated free-sheet papers grew steadily for most of the 1980s. The first major jump—11.7%—

ESTIMATED ANNUAL CAPACITIES OF U.S. UNCOATED FREE-SHEET PRODUCERS (1989)

(000 short tons)

1.	International Paper	2,100
2.	Champion International	1,114[1]
3.	Georgia-Pacific	1,100
4.	Boise Cascade	910
5.	James River	872
6.	Great Northern Nekoosa	870
7.	Weyerhaeuser	807[2]
8.	Union Camp	800
9.	Simpson Paper	450e
10.	Mead	445[3]
11.	P.H. Glatfelter	420
	Total[4]	12,352

1. 1988 production.
2. Includes Prince Albert, Sask.
3. Includes carbonless basestock.
4. Includes all other companies.

e = *Pulp & Paper* estimate.

ESTIMATED ANNUAL CAPACITIES OF CANADIAN UNCOATED FREE-SHEET PRODUCERS (1989)

(000 metric tons)

1.	Domtar	524
2.	Canadian Pacific Forest Products	190
3.	Weyerhaeuser Canada	190
4.	Rolland Inc.	165
5.	Eddy Paper Co.	160
6.	Island Paper Mills[1]	105
7.	Fraser Inc.[2]	80

1. Owned 50% by MacMillan Bloedel and 50% by Fraser.
2. Owned by Noranda Forest Inc.

Source: *Pulp & Paper Forecaster*, "Printing/Writing Papers, 1989-1998 Outlook."

RISE OF ROLLSTOCK vs SHEET-FED PAPER IN U.S. UNCOATED OFFSET FREE-SHEET PAPER INDUSTRY

(% of total uncoated free-sheet shipments)

Year	Rolls	Sheets
1995	74%	26%
1990	70	30
1988	68	32
1984	66	34
1980	61	39
1975	53	47
1970	45	55
1965	35	65

Source: *Pulp & Paper* estimates.

came in 1983, after 0.1% drops in both 1982 and 1981, according to API figures. Shipments rose 4.9% in 1984, 5.9% in 1985, 7.4% in 1986, 5.5% in 1987, and 3.2% in 1988.

Mills are generally experiencing strong operating rates, despite some slackening in mid-1989. A relatively weak economic outlook for 1990 means that certain mills will have operating rates below 90%, but the industry as a whole will stay well above that level. In fact, several mills, particularly those that are nonintegrated, took downtime in 1989 because of slower demand and exceptionally high pulp prices.

In the early 1980s, mills operated at rates below 90%. In 1981, the operating rate for uncoated free-sheet mills was 89.1%, which fell to 86.4% in 1982. The market began to strengthen, and operating rates rose to 93.3% in 1983, 91.0% in 1984, 92.2% in 1985, 94.4% in 1986, and 95.5% in both 1987 and 1988. Utilization rates are forecast to drop to about 94% in 1989 and 1990.

John D. Maine, vice president-printing and writing papers at Resource Information Systems Inc., said at the White Papers & Office Automation Conference that "the U.S. market for uncoated free-sheet paper has been a tremendous growth market in the past, and shows continuing promise for the future." Maine said that since 1982, U.S. uncoated free-sheet demand has increased a phenomenal 7%/year—from 8 million tons in 1982 to 11.9 million tons in 1988.

Maine expects a mild recession in the U.S. will dampen demand for two years. He predicted GNP growth of only 2.5% in 1989, followed by a decline of 0.1% in 1990. This still compares favorably with the 2.5% drop in GNP during the 1982 recession. Maine's outlook for 1991 to 1993 is more optimistic—3% to 4%/year growth.

Trends in the electronic office will likely benefit some grades of forms bond as well as cut-size papers used in office copiers and computer printers. "Information processing is a part of life—our society has evolved to a point where the only possible direction is toward more and better and faster information processing," said Dana G. Mead, executive vice president of International Paper, at the White Papers Conference.

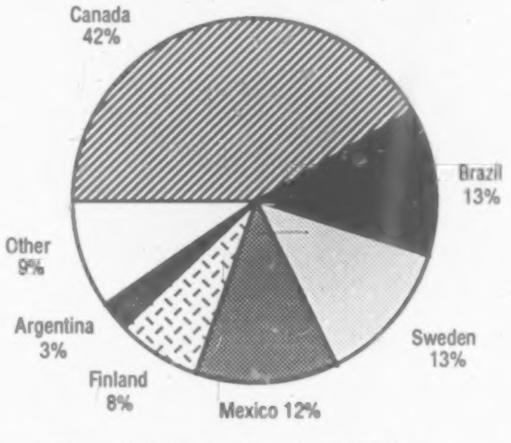
For the long term, Mead warned that "information on paper isn't information until it's read. I think information that doesn't need to be read—it only needs to be stored, for example—will be increasingly independent of paper. I think it's worth raising the question: Aren't technologies that have been driving paper growth, like other technologies, subject to change?"

Mead does not doubt that paper consumption will continue to rise. "Our industry's best candidate for the title 'Raw Material of the Information Age' is uncoated free-sheet." He added, "We see operating rates in the nineties into the 1990s . . . unprecedented demand for computer paper and copier paper has kept supplies tight."

Mead also said that "information workers" use a lot of paper. "According to some estimates I've seen, every white-collar worker used 18,000 sheets of paper [in 1988], will use 22,000 [in 1989], 26,000 [in 1990], and so on until . . . who knows how long this will go on?"

Despite his optimistic outlook, Mead pointed to some potential problems facing the white papers industry, includ-

U.S. UNCOATED FREE-SHEET IMPORTS, 1988



Total 1988 uncoated free-sheet imports: 594,994 tons.

Source: Dept. of Commerce.

FIBER COSTS FOR PRODUCING PRINTING GRADES AT NONINTEGRATED PAPER MILLS

Year	45-lb No. 3 offset sheets ($/short ton)	Northern hardwood kraft market pulp ($/short ton)	Ratio of selling prices (pulp/paper)
1988	$1,020	$705	0.691
1987	850	522	0.614
1986	850	426	0.501
1985	800	327	0.409
1984	880	426	0.484
1983	840	381	0.453
1982	680	345	0.507
1981	878	445	0.507
1980	813	445	0.547
1979	717	393	0.548
1978	645	310	0.481
1977	555	250	0.450
1976	506	300	0.592
1975	484	335	0.692
1974	535	335	0.626
1973	457	225	0.492
1972	460	135	0.293
1971	455	135	0.296
1970	442	155	0.351

Note: All prices are year-end.

Source: *Pulp & Paper Pricebook 2.*

ing world literacy and environmental barriers. The greatest potential opportunity for growth is in countries where illiteracy is highest. In addition, Mead said, paper manufacturers face concerns about pollution abatement, waste disposal, dioxins, product contamination, and employee health.

Mills will continue to benefit from current trends in information processing and office printing. However, forms bond shipments in 1988 declined about 0.5% from the previous year, following massive increases in previous years (e.g., 12% from 1985 to 1987). On the other hand, production of bond and writing papers, which includes cut-size reprographic grades, increased more than 7% in 1988.

Paper prices have been strong since late 1986, despite minor discounting on cut-size and offset printing papers in first-quarter 1987. Prices strengthened again, but by the beginning of 1989, new capacity and declining demand brought favorable discounts to buyers. By the third quarter of 1989, discounts on offset grades were as high as $60 to $80/ton, while prices for cut-size copy papers were off by $20 to $40/ton.

Dept. of Commerce figures show a jump of almost 37% in uncoated free-sheet imports into the U.S.—from 433,000 tons in 1987 to almost 595,000 tons in 1988. Canada was the major exporter, shipping over 248,000 tons of uncoated free-sheet papers to the U.S. in 1988. Scandinavian countries followed with more than 121,000 tons. Brazil shipped over 79,000 tons, and Mexico shipped almost 74,000 tons.

OFFSET PAPERS

Offset papers are part of the family of book papers, which can include tablet and envelope paper as well as offset. All of these grades are used for printing and graphic arts purposes, and they can be readily produced on the same machines as printing papers. Properties that distinguish one grade from the other include surface finish, opacity, brightness, and bulk.

Offset paper is shipped to other customers besides b[illegible] publishers. While slightly over 2.8 million tons of uncoated offset paper were produced in 1988, shipments to book publishers of uncoated free-sheet totaled 630,000 tons. Not all paper used to print books is uncoated free-sheet, although the percentage is growing modestly. Uncoated free-sheet represented 60% of the 1.040 million tons of paper shipped to book publishers in 1988. Uncoated groundwood represented 8%, and coated grades represented another 32%.

Consumption of uncoated free-sheet paper for books rose 23% from 1978 to 1988, compared with a 32% gain by coated papers. During the same period, the small market for uncoated groundwood book papers fell 20%.

In 1988, shipments of uncoated free-sheet paper to commercial printers rose more than 4%—only half the gain recorded in 1987 from the previous year. Coated advanced approximately 5%, and uncoated groundwood gained almost 63%.

Offset papers are sold either in rolls or in sheets (cut or folio sizes). In 1988, rolls made up about 68% of all offset paper shipments. Paper roll di-

NEW U.S. AND CANADIAN UNCOATED FREE-SHEET CAPACITY THROUGH 1992

Company, U.S.	**Location**	**Annual capacity (short tons)**	**Year**
Hammermill	Selma, Ala.	185,000	1986
Boise Cascade	Wallula, Wash.	40,000	1987
Champion International	Pensacola, Fla.	260,000	1987
Georgia-Pacific	Port Hudson, La.	290,000	1988
International Paper	various	200,000	1988-90
Champion International	Courtland, Ala.	40,000	1989
Hammermill	Selma, Ala.	35,000	1989
Kimberly-Clark	Whiting, Wis.	30,000	1989
Champion International	Pensacola, Fla.	120,000	1989
Willamette	Bennettsville, S.C.	255,000	1990
Champion International[1]	Quinnesec, Mich.	(net) 58,000	1990-91
Great Northern Nekoosa	Ashdown, Ark.	80,000	1990
Union Camp	Eastover, S.C.	50,000	1990
Boise Cascade	International Falls, Minn.	308,000	1990
Great Northern Nekoosa	Ashdown, Ark.	325,000	1991
Union Camp	Eastover, S.C.	240,000	1991
Weyerhaeuser[2]	Columbus, Miss.	200,000	1992
Bowater	Calhoun, Tenn.	340,000	1992
Champion International	Courtland, Ala.	140,000	1992
Company, Canada	**Location**	**(metric tons)**	**Year**
Domtar[3]	Windsor, Que.	160,000	1987
Weyerhaeuser Canada	Prince Albert, Sask.	217,000	1988
Domtar	Windsor, Que.	160,000	1989
Canadian Pacific Forest Products	Dryden, Ont.	175,000	1989

North American capacities, 1989
U.S.: 12.352 million short tpy
Canada: 915,000 metric tpy (estimated)

1. Initially will produce uncoated free-sheet, but designed for coated.
2. Machine announced or discussed in principle, but plans not finalized.
3. During 1986-89 period, Domtar will also be shutting down 97,000 tpy of old machines.

Sources: *Pulp & Paper Week* estimates, American Paper Institute, Canadian Pulp & Paper Assn.

ameter and width must be standardized to meet the needs of printers. For stock roll grades, typical diameters are 32 and 40 in. Standard widths are 11, 17, 22, and 35 in. Buyers usually pay a trim penalty when ordering unstocked sizes.

Offset and other uncoated book papers are designed to run on high-speed offset presses. The sheet surface is sized externally at a size press on the paper machine to prepare it for the slight wetness inherent in offset printing. A high degree of resistance to picking is also essential.

Opacity is produced by titanium dioxide and other fillers. Quality and price of the sheet vary because of the wide array of furnishes, fillers, and brightnesses that are available. Opacified offset paper is often preferred because it has a slightly higher brightness and a 2% to 3% higher opacity rating than standard offset book paper. Mills typically make several grades to meet the specific requirements of printing quality and price. Typical properties for a No. 1-type offset sheet are listed in this section.

Recycled fiber or mechanical pulp in the furnish produces lower-priced offset paper that retains relatively high opacity levels but with a lower brightness rating. Uncoated book papers also vary in bulk and sheet surface, with bulk influenced by changes in basis weight as well as in surface treatment. Common sheet surfaces include antique, eggshell, woven, and English.

LIGHTWEIGHT PRINTING GRADES

Lightweight printing (LWP) grades generally have a basis weight around 40 lb (25 x 38 in., 500 sheets), and they are used for products ranging from Bibles to business forms. At least for forms bond, the very lightest basis weights are no longer favored, as multi-part business forms give way to single-part forms requiring stronger surfaces. In this area, the trend is toward basis weights between 18 and 20 lb, although 15 lb is still the most common.

In LWP grades, opacity should be about 85% when the paper has more than a 26-lb basis weight. Heavy use of fillers helps accomplish this goal. Even lighter papers, ranging from 19 to 24 lb with opacities of 80% to 85%, are used for Bibles. Lightweight grades are also used when page weight and bulk must be reduced in books and catalogs.

Various fibers are used to make LWP grades, including chemical pulps, cotton fiber, flax straw, or combinations thereof. Production data for these grades, except cotton, are not available.

COVER AND TEXT PAPERS

Cover and text papers are heavier in weight than offset papers. They are used as covers for magazines, pamphlets, and paperback books, as well as for text pages in these publications. Cover and text papers can be as heavyweight as bristols, and they are sold in coated as well as uncoated grades. Cover stock can be embossed, coated, plastic-coated, or laminated with cloth.

Cover and text papers provide better quality for a higher price than offset paper. They are made in a variety of colors and finishes, and they are manufactured by the same companies that make offset and bond papers. Bleached board producers such as Federal Paper Board Co. Inc. and Temple-Eastex Inc. also make cover stock, especially coated cover.

Demand for these grades has grown about 4.8%/year since 1979, reaching more than 302,000 tons in 1988. A brief decline in 1985 was caused by a somewhat weakened economy. Production of text papers was over 195,000 tons in 1988 and represented about 65% of this market.

BMDX PAPERS

Bond, mimeograph, duplicating, and copy (BMDX) grades are similar in sheet property and basis weight, and many mills make the same paper for more than one end use. Mills often swing among grades depending on market demand. These grades are internally and surface sized because they

BASIS WEIGHT AND BULK OF LWP PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Typical bulk (sheet/in.)
19* (28 g/m²)	1,360
20* (30 g/m²)	1,290
22* (33 g/m²)	1,180
24* (36 g/m²)	1,080
26 (38 g/m²)	900/940
28 (41 g/m²)	870/900
30 (44 g/m²)	810/850
33 (49 g/m²)	740/790
35 (52 g/m²)	690/700
40 (59 g/m²)	610/640

* Bible grades.

TYPICAL GRADE STRUCTURE FOR 100% FREE-SHEET OFFSET PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Grammage (g/m²)	Opacity[1] (%)
35	52	82%
40	59	86
45	67	87
50	74	89
55	81	91
60	89	90
70	104	92
80	118	94

1. Government specifications for offset book printing paper; however, these are similar to those used by most companies for high-quality offset with brightness of 80-85.

U.S. PRODUCTION OF UNCOATED COVER AND TEXT PAPERS

(000 short tons)

Year	Cover	Change (%)	Text	Change (%)
1988	102	-1.9%	194	2.1%
1987	104	8.3	190	5.6
1986	96	10.3	180	5.9
1985	87	3.3	170	2.9
1984	90	5.9	175	9.4
1983	85	13.3	160	18.5
1982	75	—	135	6.9
1981	75	1.3	145	10.5
1980	76	5.0	162	0.5
1979	80	8.1	163	18.1
1978	74	8.8	138	13.1
1977	68	19.3	122	2.5
1976	57	32.6	119	5.3
1975	43	17.3	113	29.8
1974	52	5.5	161	2.4
1973	55	12.2	165	13.0
1972	49	14.0	146	5.8
1971	43	—	138	—

Source: *Pulp & Paper* estimates.

PRODUCERS OF LWP AND THIN PAPERS

Lightweight printing

Allied Paper Inc.
Jackson, Ala.

P.H. Glatfelter Co.
Neenah, Wis.

James River Co.
Kalamazoo, Mich.

Fletcher Paper Co.
Alpena, Mich.

Fraser Paper Ltd.
Madawaska, Maine

Kimberly-Clark Corp.
Lee, Mass.[1]
Neenah, Wis.

Ecusta Corp.[3]
Pisgah Forest, N.C.

Port Huron Paper Co.
Port Huron, Mich.

Sorg Paper Co.
Middletown, Ohio

Champion International Corp.[2]
Deferiet, N.Y.

Cigarette

Kimberly-Clark Corp.
Spotswood, N.J.[1]
Ancram, N.Y.[1]

Ecusta Corp.
Pisgah Forest, N.C.

1. Schweitzer Div.
2. Formerly St. Regis Paper Co.
3. Div. of P.H. Glatfelter Co.

are also commonly used for offset printing.

They are generally made from 100% chemical pulp, with opacity in the mid- to high 80s and brightness in the low to mid-80s. Some cotton fiber may be used in high-quality bond papers, which are discussed in the Cotton Fiber chapter.

Bond papers. As office copiers and computer printers became more pervasive during the past three decades, the demand for bond papers rose dramatically. Annual shipments of bond and writing papers were 372,000 tons in 1960. By 1988, that figure had risen to 2.8 million tons, which was a 7% increase from the year before.

Office electronics and electronic communications have not seriously dented paper demand. (See Electronic Competition chapter.) While the day of the paperless office may yet arrive, current technology has actually encouraged more paper use.

Placements of personal computer printers in the U.S. are expected to jump from 5.64 million in 1987 to 7.62 million in 1992, according to CAP International, a market-research company based in Norwell, Mass. Demand for printer paper will increase at a 6% cumulative average growth rate, according to the 1989 annual statistical report by Datek Imaging Services, a CAP unit. Cut-size paper (usually $8^{1}/_{2}$ x 11 in.) will continue gaining market share at the expense of continuous computer paper. By 1991, cut-size will account for 30% of pages consumed by computer printers. In contrast, multi-part custom continuous forms will decline 3% cumulatively, and stock continuous forms will fall 1%, according to Datek.

Uncoated free-sheet bond represented 94% of all U.S. shipments to business forms converters in 1988. Most of the balance was met by uncoated groundwood shipments of 170,000 tons, which had dropped 25% from 1987.

Advances in photocopying, such as availability of color, will push paper consumption upward at a compound annual growth rate of 4% from 1986 to 1991, according to the Datek report. Mead Corp. invented both a process and a paper/film substrate to go with its Cycolor process.

According to analysts at Dataquest Inc., a market re-

COVER AND TEXT PAPERS: TYPICAL GRADE STRUCTURE

Text		Cover	
Basis weight (25 x 38, 500)	Grammage (g/m^2)	Basis weight (20 x 26, 500)	Grammage (g/m^2)
60	89	50	135
65	96	60	162
70*	104	65*	176
75	111	80*	216
80*	118	90	243
100	148	100	270

* Major weights.

search firm, demand for office-related papers will continue growing as placements of computer printers and copying machines increase. The dollar value of cut-size paper consumption is expected to grow at a compound annual rate of 16.2% from 1988 to 1993. The value of continuous forms will grow at about half that rate, said Richard C. Norton of Dataquest.

Placements of plain-paper copiers increased 14.1% compound annually during the 1983-88 period, Norton said, and from 1988 to 1993, placements will advance by about 4.7%. By 1993, Americans will be making 748 billion photocopies annually—a figure 6% higher than in 1988.

The way in which end users buy copier paper is also changing, according to Susan Drain, an imaging supplies industry analyst at Dataquest. Drain said a recent survey showed that almost 19% of end users buy Hammermill paper, while 17% buy from Xerox. Printer manufacturers such as Kodak supply 12%. Mead supplies about 8% of end-user needs, and Boise Cascade handles 6.7%. Another 37% of end users buy from others sources, such as Quill, a catalog retailer of office supplies and equipment.

According to two-thirds of the survey respondents, price is the main reason they buy from independent sources. Most who buy from equipment manufacturers do so because it is part of their equipment contracts and because they feel they get a break on prices.

Bond papers come in various qualities and prices to meet a range of office and stationery needs. At mid-year 1989, a typical No. 4 bond (20 to 24 lb) had a list price of $1,020/ton, with discounts of $40 to $60/ton.

Copy papers. Paper for copy machines must remain compatible with changes in copying technology, such as the increasing use of recycled and alkaline grades, reproduction on color copiers, new furnishes like bleached CTMP, and more use of coated papers.

Copiers continue to use cut-size paper measuring 8½ x 11 or 8½ x 14 in. However, a few machines such as the IBM Copier II and the Xerox 1860 are roll-fed. High-speed copiers can achieve rates of 120 pages/min or more, while inexpensive copiers may produce as few as six pages/min. Cut-size copy paper is produced on the same machines that make offset and forms bond papers, because all of these grades have similar characteristics and are produced from chemical pulps.

Advances in copier technology have placed new demands on paper, according to George Treier, principal engineer at Xerox's Paper Technology Center. At the White Papers & Automation Conference, Treier singled out the following technological developments: systems and post-imaging applications that require customized applications using a range of stocks, as well as preprinted and perforated papers; higher speeds and higher-resolution xerography using laser imaging and electronics; color xerography; ionography (ion deposition printers); and inkjet technology in the low- and medium-usage segments of black and white as well as color copying.

Treier said imaging paper has to meet or exceed all runability and sheet-handling requirements within any operational mode and environment. Copy papers should not attract dust and debris, in order to protect the copying machines from damage. Copy paper must also meet the "customers' aesthetic or social consciousness needs" by be-

PAPER SHIPMENTS TO U.S. BOOK PUBLISHERS, 1980-88

(000 short tons)

Year	Coated two side Total	Coated two side Nos. 1-4	Coated two side No. 5	Uncoated free-sheet	Uncoated groundwood	Total
1988	331	263	70	630	82	1,043
1987	300	245	53	560	70	930
1986	298	238	60	524	68	890
1985	280	223	57	454	53	787
1984	289	219	70	482	70	841
1983	250	190	60	435	75	760
1981	250	165	85	460	105	815
1980	240	150	90	475	115	830

Source: *Pulp & Paper* estimates.

TYPICAL BULKS FOR BOOK PAPERS AT DIFFERENT BASIS WEIGHTS AND SHEET FINISHES

Basis weight (25 x 38, 500)	Standard bulks Antique (ppi)*	Standard bulks Eggshell (ppi)*	Standard bulks Standard (ppi)*	Standard bulks English finish (ppi)*
45	—	492	540	600
50	410	440	488	540
55	360	386	444	500
60	330	364	408	440
70	288	316	350	390

* ppi = Pages (sheets) per inch.

Source: International Paper Co.

ing "environmentally friendly." In addition, the paper should be easy to handle, and it must be affordable.

While demand for base paper for facsimile machines is strong, demand for other coated copy papers will remain weak.

FORMS BOND

Forms bond, a less expensive cousin of copy paper, is used on high-speed, continuous data-processing equipment that employs direct-impact printing methods. Desired qualities include stiffness and strength for fast feeding and printing and for refolding without distortion, lint-free printing surface, proper dimensional stability for perfect register, and high degree of paper cleanliness.

Unlike most other uncoated free-sheet grades, forms bond competes directly with uncoated groundwood grades that are substantially less expensive. Top-quality forms bond is made of 100% chemical pulp fiber, often made by blending softwood and hardwood kraft pulps. Forms paper also may have some secondary (recycled) fibers, groundwood pulp, or bleached CTMP to reduce both production cost and sales price. The price for blended (free-sheet/groundwood) forms sheets can be as much as 25% below that for free-sheet bond in a normal market. Primarily groundwood forms papers are priced at around 50% below free-sheet prices.

Among the leading producers of free-sheet forms bond are Boise Cascade, International Paper/Hammermill Papers, Mead, Union Camp, and Georgia-Pacific. G-P also makes blended bonds, and Abitibi-Price Inc. and Great Northern Nekoosa Corp. are strongest in groundwood forms paper. Groundwood forms paper often is not surface-sized, thus reducing printing press runability and printability. Groundwood paper also has lower brightness and opacity than the free-sheet product, but it is much cheaper.

Forms bond accounted for about 19% of all uncoated free-sheet shipments in 1988. Of shipments to forms converters, free-sheet represented 94% of the total. The remaining 170,000 tons was groundwood papers, which have been declining as a percentage of the total forms market for several years.

A study by the U.S. forms industry indicates that growth in 1989 will continue to outpace growth in the general economy, but at a slower rate than in 1988. "Perspective 89" suggests that the industry will grow 3.1%, compared with 2.5% growth for the overall economy. Forms industry growth was 4.1% in 1988, and it was even higher in 1987—4.8%.

The study, published annually by the industry group International Business Forms Industries Inc., said that the leading growth segments will continue to be custom and stock continuous forms. However, cut-sheet products are making substantial gains due to advances in non-impact (laser) computer printers. The report also said that new printer and copier technology is causing customers to move away from pre-printed forms toward cut-sheet forms produced in-house.

Business forms sales are expected to advance about 15% overall for the 1988-93 period. Leading the industry is stock continuous forms, which are expected to climb 20% for the six-year period. Custom continuous forms will post a 13% gain. Together, these two segments account for about 72% of the total forms industry (cut-sheet not included). Salesbooks and pegboard, the smallest segment of the forms industry at about 5% of total sales, will grow 33%. Unit sets are expected to post a 7% growth rate for the period. "Perspective 89" also predicts that "a moderate growth rate of 4% will likely keep supply and demand in check" in the carbonless market.

Forms manufacturers have been squeezed by rising prices for raw materials, especially paper. But that is changing. "After having endured a very tight market with six separate price increases since January 1987, forms manufacturers may look forward to stable or even reduced prices through the end of 1989 and perhaps into 1990," the study said.

Paper prices are affected by new capacity coming online and the stronger U.S. dollar, which reduces the cost of imported paper. Quoting API figures, the study said that U.S. mills are scheduled to increase uncoated free-sheet capacity 2.8% in 1989, 3.5% in 1990, and 3.7% in 1991. "These above-average rates of capacity increments will hit at a time of slower economic advances," it said.

Canada's trade agreement with the U.S. eliminates cross-border tariffs on business forms in 20% increments over a five-year period that began on Jan. 1, 1989.

CARBONLESS PAPER

Over the past 17 years, carbonless paper has been one of the fastest-growing segments of the paper industry, according to James W. Gibson, industry manager, carbonless and forms grades, at Mead's Fine Paper Div.

Carbon paper is rapidly being replaced

COMMON BASIS WEIGHTS FOR BMDX GRADES

Basis weight (17 x 22, 500)	Grammage (g/m²)	Bond	Mimeograph	Duplicating	Copy
13	49	X			
16	60	X	X	X	
18	68	X	X	X	
20	75	X	X	X	X
24	90	X*	X		X
28	105	X*			
32	120	X*			
36	135	X*			

* Ledger grades.

by carbonless paper in end uses such as business forms, order books, and charge-card receipts. With carbonless paper, the image is transferred from the top or "donor" sheet to succeeding sheets with the aid of an encapsulated dye coated onto the back side of the paper. When the top surface is imprinted, the pressure breaks the dye on the back, and the image is transferred to the top of the next sheet. The receiving side is coated with kaolin clay in order to enhance the sharpness of the received image. This system makes up to five replicas.

A carbonless forms unit generally has a basestock (cb) made from high-quality chemical pulps on a standard four-

U.S. PRICES FOR UNCOATED WHITE PAPER

($/short ton)

Year	Offset 50-lb rolls	Bookpaper No. 3 offset +45-lb sheets	Bond, No. 4 unwatermarked 20 to 24-lb sheets	No. 1 watermarked +20-lb sheets	Forms bond 15-lb rolls	Bond 25% cotton sheets	Carbonless coated-back 15-lb rolls
1989							
2Q	$900	$1,020	$1,020-1,040	$1,090-1,100	$(880)	$2,200	$1,960
1Q	900	1,020	1,040	1,090-1,100	(880)	2,200	1,960
1988							
4Q	880-900	1,020	960	1,090	910	2,200	1,960
3Q	840-850	960	920	1,080	850/870	2,200	1,904
2Q	810	920	880	1,070	850/870	2,125	1,904
1Q	770	870	840	1,030	800	2,125	1,778
1987							
4Q	750	850	820	980	760	1,990/2,060	1,778
3Q	750	820	727-747	(920)/985	760	1,900	(1,660)
2Q	(640)	820	760	(930)/985	720*	1,810	(1,625)
1Q	(640)	820	(720)/820	(930)/985	720*	1,810	(1,625)
1986							
4Q	700	850	820*	985*	720	1,810	1,710
3Q	706	850	807	985	687	1,810	1,710
2Q	(663)	(840)	(760)	985	(660)	1,810	1,593
1Q	(597)	(800)	(760)	985	(620)	1,810	1,458
1985							
4Q	(567)	(800)	(760)	985	(600)	1,810	1,355
3Q	(578)	(817)	(773)	985	(640)	1,810	1,355
2Q	(600)	(830)	(760)	985	(660)	1,810	1,355
1Q	(560)	(790)	(733)	985	(660)	1,810	1,355
Year-end							
1984	(600)	(880)	(773)	985	(693)	1,810	1,355
1983	690	840	810	960	745	1,650/1,730	n.a.
1982	(540)	680	640	916	640	1,650	n.a.
1981	690	878	867	916	753	1,650	n.a.
1980	n.a.	813	803	848	697	1,490	n.a.
1979	n.a.	711/717	720	778	620	1,309/1,343	n.a.
1978	n.a.	645	640/644	695	538/550	1,190/1,230	n.a.
1977	n.a.	548/555	548/590	645/650	450/500	1,143	n.a.
1976	n.a.	506	561	628	519/520	1,083	n.a.
1975	n.a.	484	550	605	495/504	1,012	n.a.
1974	n.a.	535	559	637	470	984	n.a.
1973	n.a.	457	495	n.a.	n.a.	734	n.a.
1972	n.a.	460	470	n.a.	n.a.	728	n.a.
1971	n.a.	455	460	n.a.	n.a.	719	n.a.
1970	n.a.	442	445	n.a.	n.a.	n.a.	n.a.

( ) Indicates estimated transaction prices where most volume is moving significantly below list.
* Discounting from list prices reported.
n.a. = Not available.

Sources: *Pulp & Paper Pricebook*, *Pulp & Paper Week*.

drinier paper machine. The receiving sheet is coated on the paper machine, and the stock then goes to an off-machine coater for the encapsulated dye. When more than two sheets are desired for a set of forms, the intermediate sheets (cfb) are coated on the front with kaolin and on the back with dye. The last sheet (cf) is coated on the front, but not on the back, with a top coating to receive the image.

Carbonless paper is used to construct multi-part business forms, which underwent substantial growth during the 1970s and 1980s, Gibson told delegates to the White Papers & Office Automation Conference. Forms paper shipments rose from about 1.1 million tons in 1971 to almost 3.5 million tons in 1988, he said.

Gibson also said that "since 1971, the use of carbonless paper in the United States has grown at a compound annual rate of 12%." That growth is a result of several factors, including general economic growth and the proliferation of computers and computer printers.

Carbonless has grown faster than other forms grades, and its growth has come at the expense of carbonizing tissue. Gibson said that in 1971 about 80% of multi-part forms in the U.S. used interleaved carbon paper and 10% used carbonless. The remainder used carbon applied directly on the back of carbonizing bond. By 1987, those figures had changed substantially, with 50% of multi-part forms using carbonless and 40% using carbon.

CARBONIZING BASESTOCK AND CARBONIZING TISSUE PRODUCTION

(000 short tons)

Year	Carbonizing	Carbonless
1988	97	689
1987	109	600
1986	117	539
1985	125	498
1984	141	443
1983	150	390
1982	180	370
1981	180	320
1980	181	295

Source: *Pulp & Paper* estimates.

FORMS BOND: TYPICAL GRADE STRUCTURE

Basis weight (17 x 22, 500)	Grammage (g/m^2)
9	34
10	38
12	45
15	56
16	60
18	68
20	75
24*	90
28*	105
32*	120

* Ledger/tag weights.

The outlook for carbonless depends on these factors: acceptance of electronic data interchange as a substitute for forms use, the growth rate of non-impact printers, and elimination of carbon paper. Gibson expects carbonless to continue growing until it accounts for 80% or more of the multi-part forms market—perhaps a growth rate of 4% to 6%/year through 1993. Ralph L. Waehner, president of Moore Business Forms & Systems Ltd.-Canada, told delegates at the conference that shipments of carbonless paper may grow nearly 9%/year through 1993. His company estimated North American production of carbonless basestock was 920,000 tons in 1988. Industry sources indicate that U.S. shipments of carbonless basestock in 1988 were nearly 690,000 tons.

Appleton Papers Inc. is the leading producer of carbonless basestock and a major converter as well. The company applies the dye on off-machine coaters, and then rolls the paper into sets. Other major converters include 3M Co., Moore Business Forms (about 240,000 to 250,000 tpy), Standard Register Co., and Nashua Corp. Mead also is a force in the market, producing about 150,000 tpy of basestock. It developed a process called "opas" that allows production of carbonless forms at printing plants through modification of existing offset presses, thus allowing printers to expand their use of carbonless paper.

Moore Business Forms is shifting from blue-image to black-image carbonless. Other large producers and converters, such as Standard Register, are also changing some of their production from blue-image paper.

THIN PAPERS

One-time carbonizing (OTC) tissue is the major segment of the thin papers grade, accounting for about 99% of thin paper shipments in the U.S. Other thin papers include cigarette and condenser papers, Bible paper, and papers for specialized uses such as lens cleaning and stencils.

Use of OTC paper is dwindling as carbonless moves into the multi-part forms area. Carbon paper is produced by coating carbon black or pigments onto a bleached or unbleached basesheet with a converter, and then combining the basesheet with a bond sheet. OTC forms are losing market share in multi-part forms at about 7%/year—the same rate that carbonless is gaining share.

Basis weights for thin papers vary widely, but a typical weight (20 x 30 in., 500 sheets) is 8.65 lb. The sheet is made on a yankee fourdrinier paper machine at medium speeds of 2,000 fpm. Chemical furnish is used, and it is refined to form a tight sheet devoid of pinholes.

Cigarette paper is a strong, highly filled lightweight product made largely from flax straw. The controlled burning rate is accomplished by heavily filling the paper with precipitated calcium carbonate. Principal producers in the

U.S. are P.H. Glatfelter Co.'s Ecusta Paper Div. and Kimberly-Clark Corp.'s Schweitzer Div. Cigarette smoking in the U.S. has declined because of government restrictions and repeated health warnings and also because of a shift in consumer attitudes about personal health.

According to industry statistics, production of thin papers has continued declining from previous years. However, at least one papermaker is bullish on prospects for lightweight printing and cigarette papers. "We don't see any reason to anticipate that business won't continue strong throughout the balance of [1989]," said M.A. Johnson, executive vice president/treasurer/chief financial officer for Glatfelter. The company's Ecusta Div. produces about 300 tpd of thin, fine, and specialty technical papers at its Pisgah Forest, N.C., mill. Johnson said that exports are pushing cigarette paper sales now that certain trade barriers have been reduced or eliminated with Japan, Rep. Korea, and other countries.

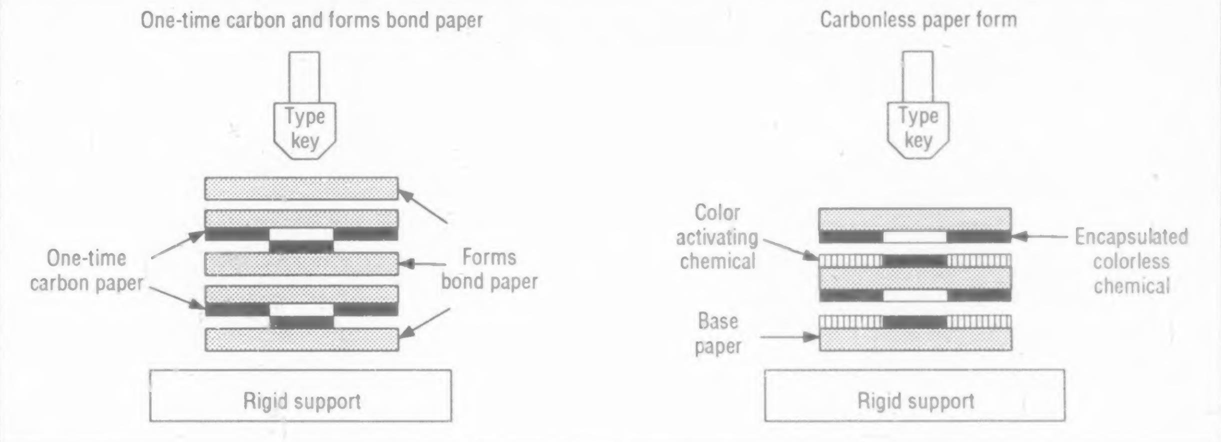
Elimination of trade barriers is important because cigarette smoking is declining in the U.S. at about 1% to 2%/year, according to Seth Moskowitz, public relations representative for R.J. Reynolds Tobacco Co. USA. Reynolds introduced—and immediately withdrew from the market—its "smokeless" cigarette, which used seven types of paper. Conventional cigarettes use three types.

Bible and other thin printing papers are growing very slowly, said Jack Sweitzer, director of market research at K-C's Schweitzer Div. Yet imports, not including cigarette grades, are rising.

Despite the drop in demand for most thin paper grades, prices have remained stable. However, production costs are growing faster than some prices. And compared with the number of price increases for all printing/writing grades since 1986, prices for thin papers have not kept pace.

Electrical paper includes several grades such as insulating, condenser, capacitor, and dielectric. Production of these papers probably is less than 20,000 tpy combined. However, some electrical papers, such as insulating paper, are listed under "special industrial papers," and their tonnages are discussed elsewhere in the book.

STRUCTURE OF ONE-TIME CARBON AND FORMS BOND PAPER VS CARBONLESS PAPER



Paper:

COTTON-FIBER

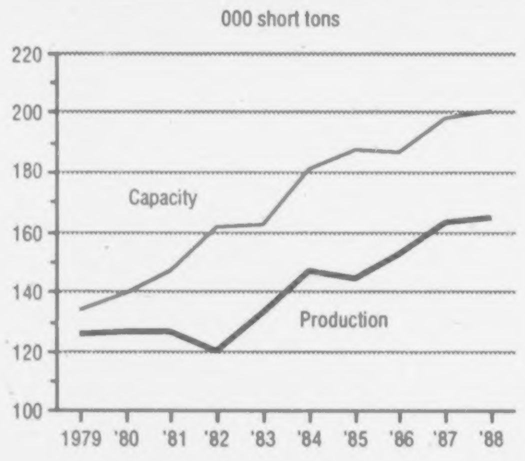
Cotton fiber is used in premium-quality bond papers, technical papers, and special papers requiring permanence and durability, such as paper currency, financial certificates, and postage stamps. Papers in this category contain between 25% and 100% cotton fiber.

Fiber generally comes from two sources. The first is new cotton cuttings from the textile and garment industries. Fabric sources include unbleached muslin, white shirt cuttings, light prints, and blue denims. The second source is cotton linters, which are the short fibers adhering to cotton seed after the ginning operation. These fibers consist of the stumps or bases of the longer staple textile fibers and short fuzz fibers. "Old rags" are not as common a source as they were when the paper was called "rag bond."

Cotton, whether in the form of cotton linters or of staple fibers used in the textile industry, is the purest natural form of cellulose (98% to 99% alpha content), and this gives cotton-content paper its durability. The cotton fiber used in cotton-content paper is usually blended with sulfate or sulfite woodpulp. The blended pulp is highly refined or beaten to develop a sheet with crackle and good strength. It is sized internally (beater sizing) to produce a proper level of holdout to inks. For a cockle finish, the sheet is air-dried.

Cotton-content papers are sold in basis weights of 9, 13, 16, 20, and 24 lb (17 x 22 in., 500 sheets). They are also labeled according to sheet finishes such as light cockle, cock-

CAPACITY AND PRODUCTION, 1979-88



Source: American Paper Institute.

COTTON-CONTENT PAPERS: GRADE DISTRIBUTION

(short tons)

Year	Total cotton-fiber	Bond and writing
1989e	164,000	138,600
1988	163,000	137,000e
1987	162,800	136,100
1986	152,000	125,400
1985	144,100	117,400
1984	147,200	119,400
1983	132,700	105,900
1982	120,200	94,800
1981	125,600	95,300
1980	126,300	95,200
1979	124,600	93,100
1978	114,400	84,400

Note: All figures revised from *1988 Factbook.*
e = Estimate.

Sources: American Paper Institute, Dept. of Commerce.

le, smooth, vellum, and linen. In addition, they are categorized according to their colors and sheet properties, such as whiteness, opaqueness, and onionskin.

Shipments of cotton-content paper have been relatively static in recent years. U.S. shipments in 1978 were 114,400 tons. They rose to 124,600 tons in 1979 and to 126,300 tons in 1980, but then fell back to 125,600 tons in 1981 and to 120,200 tons in 1982. Shipments jumped to 132,700 tons in 1983 and to 147,200 tons in 1984. After dropping slightly to 144,100 tons in 1985, they rose in both 1986 and 1987 to 152,000 and 162,800 tons, respectively, according to the Dept. of Commerce. The American Paper Institute said that shipments remained about the same in 1988.

Production is likely to grow about 2.4% annually between 1989 and 1998, compared to 4.4%/year from 1978 to 1988. Nearly all of the growth will be in bond and writing grades, rather than technical and specialty grades.

Operating rates have been below 90% since 1980. They are expected to dip below 85% until 1992, when they will rebound slightly and remain at about 85% until 1996.

Cotton-bond pricing saw its strongest leap in 1980, with an increase on 25% cotton bond in sheets moving to a yearly average of $1,442/short ton from $1,274 in 1979. Subsequent years brought increases varying from 7.4% to a mere 0.6% in 1983 to no effective increase in 1986. Indeed, by year-end 1984 the price for 25% cotton in sheets rose to an average of $1,810/short ton and hit $2,200 by second-quarter 1989.

Only 20 companies produce significant tonnage of cotton-fiber papers. These mills are usually small and based in the Northeast and upper Midwest. Because most of these mills can also produce bond-type grades from 100% chemical-pulp furnish, production is controlled mainly by demand rather than capacity.

U.S. capacity has remained relatively flat for the past 15 years. According to API forecasts, only 1,000 tons are expected to be added by 1991. Other industry sources estimate capacity in 1998 will be 242,000 tons.

NORTH AMERICAN PRODUCERS OF COTTON-CONTENT PAPERS

	Company/mill	Capacity[1] (tons/day)
1.	Sorg Paper Co., Middletown, Ohio[2]	320
2.	Howard Paper Mills Inc., Dayton, Ohio	225
3.	Strathmore Paper Co., Turners Falls, Millers Falls, Westfield, and Woronoco, Mass., mills[3]	200
4.	Crane & Co. Inc., Dalton, Mass.[4]	200
5.	Eastern Fine Paper, Brewer, Maine[5]	180
6.	Kimberly-Clark Corp., Neenah, Wis.[6]	175e
7.	Beckett Paper Co., Hamilton, Ohio[3]	150
8.	Gilbert Paper Co., Menasha, Wis.[7]	95
9.	Letcher Paper Co., Alpena, Mich.[8]	85
10.	Monadnock Paper Mills, Bennington, N.H.	75
11.	James River-Fitchburg Inc., Fitchburg, Mass.	60
12.	Domtar Inc., Fine Paper Div., Beauharnois, Que.	55
13.	Rising Paper Co., Housatonic, Mass.	50
14.	NVF Co., Holyoke, Mass.[9]	28
15.	Curtis Paper Co., Newark, Del.[10]	38
16.	Simpson Paper Co., Harding-Jones mill, Middletown, Ohio	30
17.	Southworth Co., W. Springfield, Mass.	24
18.	Esleeck Mfg. Co., Turners Falls, Mass.	20

e = Estimate.

[1] Total mill capacity including fine papers.

[2] Division of Mosinee Paper Corp.

[3] Division of Hammermill Papers Co.

[4] Includes Byron Weston Papers, Dalton, Mass.

[5] 35% of production is cotton. Division of Preco Corp.

[6] Includes Whiting mill in Stevens Point, Wis.

[7] Division of Mead Corp.

[8] Actual cotton production lower.

[9] Parsons Paper Division.

[10] Division of James River Corp.

PRICING TRENDS FOR BOND PAPERS

($/short ton)

Year-end	Forms bond[1]	25% cotton[2]
1989		
2Q	$(880)/910	$2,200
1Q	$(880)/910	2,200*
1988		
4Q	(880)/910	2,200*
3Q	850/870	2,200
2Q	850/870	2,125
1Q	800-810	2,125
1987		
4Q	760	1,990-2,060
3Q	760	1,900
2Q	720*	1,810
1Q	720*	1,810
1986	672	1,810*
1985	(640)	1,810
1984	762	1,750
1983	745	1,650/1,730
1982	(640)	1,650
1981	753*	1,549
1980	697	1,490
1979	620	1,343
1978	544	1,210
1977	475	1,143
1976	520	1,083
1975	500	1,012
1974	470	984
1973	—	728
1972	—	719

( ) Estimated transaction price where significant volume moving below list.

* Discounting from list prices reported.

[1] Average price for rolls.

[2] Average price for sheets.

Sources: *Pulp & Paper Week, Pulp & Paper Pricebook2.*

Paper:

BRISTOLS

Bristol papers are bleached or semibleached kraft stock, slightly lighter in weight than bleached boards but heavier than true printing/writing grades. Bristols may be solid or laminated stock, with thickness or caliper ranging from 6 to 15 pt.

Bristol grades are broken down into seven segments: tabulating index; tag and file folder; index bristols; printing bristols; postcard; coated bristols; and mill or bogus bristols, which are bristol-type recycled paperboards made on cylinder paper machines.

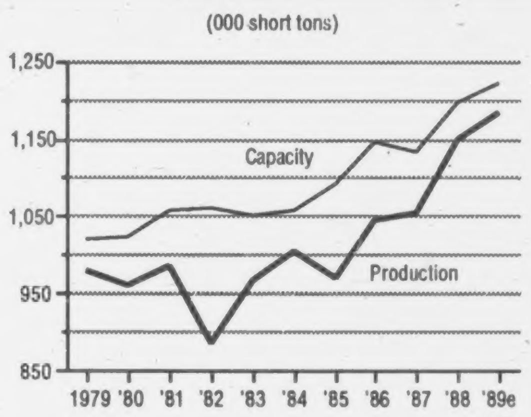
Tabulating stock, used primarily for computer tab cards, must have superior dimensional stability and electrical characteristics. It is produced on fourdrinier paper machines from semibleached kraft pulps.

Index bristols have a fairly good printing surface that is extremely erasable. Both tag and index bristols are usually produced on fourdrinier paper machines. Although both grades are similar, tag bristol is stronger and more durable.

Printing bristols are used in a variety of ways. They can be either coated one side or uncoated, and many have characteristics similar to other cover grades. Lower-caliper (between 6 and 10 pt) coated bristols are produced on fourdrinier paper machines from a blend of bleached hardwood and softwood kraft pulps. Hardwood improves the printing surface and adds bulk.

Coated bristols have end uses such as calendars, greeting cards, and directory covers, and they account for approximately half of total bristol tonnage. Generally, coated bris-

CAPACITY AND PRODUCTION, 1979-89



e = Estimate.
Sources: American Paper Institute; Pulp & Paper estimates.

U.S. STATISTICS FOR BRISTOLS*

	1989e	1988	1987	1986
Production,[1] 000 tons	1,183	1,150	1,052	1,043
Capacity, 000 tons	1,220	1,195	1,131	1,143
Utilization rate, %	97.0	96.2	93.0	91.3
Imports, tons	4,800	4,247	3,600	2,500
Exports, 000 tons	1.1	1.5	1.9	2.4
Apparent U.S. consumption				
000 tons	1,187	1,153	1,054	1,043
lb/capita	9.6	9.4	8.7	8.7
000 tons/$ billion real GNP (1982)	0.30	0.29	0.28	0.28

* = All tons are short tons.
e = Estimate.
1. Bleached bristols.

Sources: American Paper Institute, *Pulp & Paper* estimates.

tol grades are produced at large, integrated mills that also produce bleached paperboard or free-sheet paper grades.

Mill or bogus bristols extend the availability of printing bristols to calipers of 15 pt and higher. They are produced by several companies making specialty paperboard.

Major producers of bristol grades include International Paper Co., Federal Paper Board Co. Inc., Temple-Inland Inc., Union Camp Corp., James River Corp., Champion International Corp., and several smaller mills.

OUTLOOK

Overall demand for bristols has grown slowly in recent years, rising about 1%/year during the past decade. The main reason for this sluggish growth is the sharp drop in the market for tabulating card stock, which fell from about 500,000 tons in 1970 (almost half of total tonnage) to only about 30,000 tons in 1988. Excluding tab card, demand for bristols has grown a respectable 5% annually during the last decade.

About 1.102 million tons of bristols were produced by U.S. mills in 1988, up 5.5% from 1.044 million tons in 1987, according to the American Paper Institute. Mill operating rates averaged about 95% in 1988, down from about 97% in 1987. Because several bleached board producers are selling their products in bristol markets, API attributed the apparent decline in 1988 operating rates to the transfer of some bleached board capacity to bristol capacity.

The market is stable because the decline in tabulating card stock has finally bottomed out. Meanwhile, demand for file folder stock and other converting bristols is growing, as is demand for printing bristols used in paperback book and directory covers, greeting cards, promotional inserts, and direct mail materials. Sales growth of uncoated lottery and airline ticket stock is considerably higher than market growth in many other segments of the commercial printing field.

The big decline in tabulating card stock reflects displacement by computer storage media, such as tape and disks. However, production of other bristol grades used in offices, such as file folder and index stock, has grown despite dire warnings that computerized file systems would replace traditional record-keeping methods. While some analysts believe this may yet happen, statistics indicate that offices still prefer paper files as backup for computer files and for information not worth inputting on computers.

Production of bristols for file folders increased from 72,000 tons in 1970 to 214,000 tons in 1988. Index bristols, however, have shown relatively flat growth. Shipments in 1988 totaled 117,000 tons—about the same as in 1987. Coated printing bristols have shown the strongest growth, rising from 190,000 tons in 1970 to 480,000 tons in 1988.

According to Communication Information Services Inc., a market research firm based in Pleasant Hill, Calif., overall demand for bristols should rise at a 2.3% annual rate during the 1986-95 period, compared with a 1% annual rate during

U.S. CAPACITY TRENDS FOR BLEACHED BRISTOLS

Year	Annual capacity (000 short tons)	Change (%)
1990e	1,260	3.3%
1989e	1,220	2.1
1988e	1,195	5.6
1987e	1,131	-1.0
1986e	1,143	4.9
1985e	1,090	3.0
1984	1,058	1.0
1983	1,049	-1.8
1982	1,062	0.2
1981	1,060	3.5
1980	1,024	0.4
1979	1,020	-14.6
1978	1,194	2.5
1976	1,165	-5.7
1974	1,235	6.9
1972	1,155	3.9
1970	1,112	6.2
1969	1,047	—

e = Estimate.

Sources: American Paper Institute, *Pulp & Paper* estimates.

BLEACHED BRISTOL PRODUCTION BY GRADES

(000 short tons)

Year	Total	Tabulating	Tag	Folder	Index, printing, postcard	Coated
1988	1,150	40	185	195	280	450
1987	1,052	50	181	188	276	350
1986	1,043	60	182	178	270	360
1985	970	70	200	164	194	266
1984	1,003	68	214	141	215	302
1983	967	107	215	149	240	217
1982	886	123	181	117	200	213
1981	984	142	194	127	330	290
1970	1,155	500	186	72	218	179
% change 1970-88	-0.4	-92.0	-0.5	170.0	28.4	151.0

Source: *Pulp & Paper* estimates.

1976-85. Coated bristols may grow at a somewhat higher 4.4% annual rate.

Capacity increases have been gradual in recent years, following declines in the 1970s that kept the market tight. In 1979, when capacity fell to a low of just over one million tons, the operating rate reached a high of 104.6%. In 1989, capacity was expected to reach 1.168 million tons. API estimated that it will rise to 1.202 million tons by 1991. Bristol capacity is somewhat hard to pinpoint, however, because of the confusing delineation between bristols and other grades, including uncoated free-sheet, bleached board, cover/text, and boxboard. Most industry executives suspect that bristol capacity is somewhat higher than is officially reported.

PRODUCERS OF BRISTOL GRADES

Mill bristol*

Beveridge Paper Co.
Indianapolis, Ind.

Boise Cascade Corp.
Sheldon Springs, Vt.
Beaver Falls, N.Y.

Byron Weston Co.[1]
Dalton, Mass.

Lowe Paper Co.
Ridgefield, N.J.

Sonoco Products Co.
Holyoke, Mass.

Index/printing

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Champion International
Hamilton Ohio

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.
Beauharnois, Que.

E.B. Eddy Forest
Products Ltd.
Brewer, Maine
Hull, Que.

Federal Paper Board Co. Inc.
Augusta, Ga.
Riegelwood, N.C.

Fox River Paper Co.
Appleton, Wis.

Mead Corp.
Gilbert Paper Co.
Menasha, Wis.

International Paper Co.
Bastrop, La.
Moss Point, Miss.

James River-Fitchburg
Fitchburg, Mass.
Milford, N.J.

Kimberly-Clark Corp.
Neenah, Wis.

Mohawk Paper Mills Inc.
Cohoes, N.Y.
Waterford, N.Y.

Plainwell Paper Co.
Plainwell, Mich.

Rising Paper Co.
Housatonic, Mass.

Rolland Inc.
St. Jerome, Que.

Scott Paper Co.
Mobile, Ala.

Simpson Paper Co.
Vicksburg, Mich.
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Strathmore Paper Co.[2]
Westfield, Mass.

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Wausau Paper Mills Co.
Brokaw, Wis.

Whiting Paper Co.
Menasha, Wis.

Tag

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.

International Paper
Bastrop, La.
Georgetown, S.C.

Island Paper Mills Inc.[3]
New Westminster, B.C.

James River-Fitchburg Inc.
Fitchburg, Mass.

James River Corp.
Warren Glen, N.J.
Milford, N.J

Merrimac Paper Co.
Lawrence, Mass.

Potlatch Corp.
Lewiston, Idaho

Rolland Inc.
Mont Rolland, Que.

Simpson Paper Co.
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Postcard

Domtar Inc.
Cornwall, Ont.

Eastern Fine Paper Inc.[4]
Brewer, Maine

Hennepin Paper Co.[5]
Little Falls, Minn.

International Paper Co.
Mobile, Ala.
Ticonderoga, N.Y.

James River Corp.
Hyde Park, Mass.
Hughesville, N.J.

Lowe Paper Co.
Ridgefield, N.J.

Pejepscot Paper
Brunswick, Maine

Sorg Paper Co.
Middletown, Ohio

Wausau Paper Mills Co.
Brokaw, Wis.

* Includes bogus bristols and heavyweight bristols from bleached kraft used for posters, etc.

[1] Division of Crane & Co. Inc.

[2] Division of Hammermill Paper Co.

[3] 50% owned by MacMillan Bloedel Ltd., 50% owned by Fraser Inc.

[4] Division of Eddy Paper Co. Ltd.

[5] Subsidiary of Carlyle Investment Corp.

Market leaders Federal Paper Board and International Paper produce both coated bristols and lightweight bleached paperboard at large, integrated mills in the South, often shifting production between the two grades when they are made on the same machine. Both companies are making investments to improve their positions in the bristol market.

Federal will spend nearly $400 million to install a new lightweight coated bleached paperboard machine at its Augusta, Ga., mill in 1992. The new machine will primarily produce bleached bristol grades for the commercial printing industry. The project will add about 650 tpd—or 235,000 tpy—increasing the Augusta mill's total capacity to about 2,510 tpd—or 900,000 tpy.

BRISTOLS: TYPICAL GRADE STRUCTURE

Grade	Uses, basis-weight ranges	
INDEX: (uncoated)	Sales lists, manuals, record folders, file cards.	
	Basis:	25½ x 30½ in., 500
	Weights:	80 lb (145 g/m^2) 90 lb (163 g/m^2) 110 lb (199 g/m^2) 140 lb (253 g/m^2) 170 lb (307 g/m^2) 220 lb (398 g/m^2)
TAG: (uncoated)	Tags, ruled forms, timecards, menus, folders, catalog inserts, display cards.	
	Basis:	24 x 36 in., 500
	Weights:	90 lb (146 g/m^2) 100 lb (163 g/m^2) 125 lb (203 g/m^2) 150 lb (244 g/m^2) 175 lb (285 g/m^2) 200 lb (325 g/m^2)
POSTCARD[1]: (uncoated)	Return mailers, bills/statements.	
	Basis:	22½ x 28½ in., 500
	Weights:	57 lb (125 g/m^2) 67 lb (147 g/m^2) 80 lb (176 g/m^2)
MILL BRISTOLS[2]: (uncoated or C1S)	Promotional folders, posters, point-of-purchase displays, tent cards, covers, etc.	
	Caliper:	0.008 in. 0.010 in. 0.012 in. 0.015 in. 0.018 in. 0.020 in. 0.024 in.

1. Approximate calipers: 0.009 in. for 67 lb, 0.0075 in. for 57 lb.
2. A wide range of grades, including bogus bristols. The higher-caliper grades, above 15 pt, could be produced on cylinder machines. Also available in higher calipers.

International Paper will invest $28 million in its coated bristol machine at Moss Point, Miss., to improve quality and raise output. IP plans to broaden its Springhill coated bristol line over a two-year period by adding several new weights. Current debottlenecking and expansion projects at IP's Georgetown, S.C.; Texarkana, Texas; and Bastrop, La., mills will increase uncoated bristol capacity by about 20% by 1991.

Bristol prices hold up better than prices for other related grades of paper and paperboard, which are more vulnerable in economic slowdowns. During the 1981-82 recession, pricing for bristol grades was substantially stronger compared with other sectors that suffered from heavy discounting. In fact, some bristol price increases were implemented in early 1982—a time when almost no other printing/writing grades went up in price.

When the economy began recovering in late 1983, coated bristols rebounded sharply, posting a $50/ton price hike effective Jan. 1, 1984. However, weakening in the overall printing/writing papers market later that year caused some price weakness in bristols. Demand picked up in 1986, and a $20/ton price increase went into effect in September and again in October. Additional increases of $40 to $50/ton were implemented in the spring and fall of both 1988 and 1989.

Prices for uncoated bristols used in file folders, tabulating cards, tag stock, airline and lottery tickets, etc., have shown recent strength. Prices vary considerably among uncoated grades because of different basis weights and different printing and converting requirements. In 1989, manila file folder stock prices reached about $710/ton, and manila tag stock reached $855/ton.

BLEACHED BRISTOLS: U.S. PRICE HISTORY*

Year	Manila tag[1]	Manila file folder	C1S[2]
1989	$895	$710	$920
1988	755	620	840
1987	715	585	800
1986	715	585	800
1985	675	640	760
1984	675	640	760
1983	675	576	720
1982	581	576	670
1981	581	576	640-670
1980	521-546	521-541	565-585-605
1979	481	481	520

* Published list prices; years with multiple prices include more than one price increase that year.
1. Rolls, greater than or equal to 125-lb basis weight (24 x 36, 500 sheets).
2. Coated one side, 14-pt. caliper.

Paper:

PACKAGING AND INDUSTRIAL CONVERTING

Kraft packaging and industrial converting papers include a wide range of unbleached and bleached papers and are divided into three general categories: (1) unbleached packaging and industrial converting grades used for grocery bag and sack, shipping sack, wrapping, and other converting papers, (2) bleached packaging and industrial converting grades used for similar end uses, and (3) special industrial papers used in the manufacture of abrasives, electrical insulators, gaskets, filters, and other products. The bleached grades also include glassine, greaseproof, and vegetable parchment papers used for specialty packaging.

Unbleached grades make up nearly 60% of total production, while bleached and specialty packaging grades account for about 20% and special industrial grades represent about 20%. The most commonplace products made from kraft paper are grocery sacks, shipping sacks, and retail merchandise bags. The four major end uses for unbleached and bleached kraft packaging and industrial converting papers are bag and sack (57% of shipments), shipping sack (25%), wrapping (3%), and other converting (15%).

U.S. STATISTICS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

	1989e	1988	1987	1986
Production[1], 000 short tons	4,881	5,047	4,955	5,117
Capacity[1], 000 short tons	5,410	5,394	5,492	5,758
Utilization rate, %	90.2	93.6	90.2	88.9
Imports, 000 short tons	375	343	310	243
Exports, 000 short tons	347	347	294	284
Apparent U.S. consumption				
000 short tons	4,909	5,043	4,971	5,076
lb/capita	39.5	41.1	40.9	42.2
000 tons/$ billion real GNP (1982)	1.23	1.29	1.30	1.37

e = Estimate.
1. American Paper Institute.

Kraft papers for bag and sack production are made in many basis weights. Small bags designed to hold $^1/_4$ lb to 25 lb of product are made from paper with basis weights of 30, 35, or 40 lb/3,000 ft^2—equivalent to 49 to 65 g/m^2. In contrast, sacks are designed to hold more product, and they are made from paper with basis weights of 40 to 80 lb/3,000 ft^2—or 65 to 130 g/m^2. Typical sack weights are 40, 52, 57, 65, 70, 75, and 80 lb. Standard grocery sacks use 70-lb kraft paper, while 50-lb paper is used in shipping sacks.

Because bags and sacks are made for many different purposes, their weight, style, and construction are tailored to each end use. Bags and sacks are standardized in four sizes ($^1/_8$, $^1/_6$, $^1/_5$, and $^1/_4$ of a bushel), and they are primarily produced in one of four styles: flat, gusset, satchel-bottom, and self-opening. Sack construction may also be single-wall, heavy single-wall, duplex, or multiwall. If needed, the machine-direction (MD) strength of kraft paper may be increased during the drying stage of the papermaking process. This extensible kraft paper absorbs more shock without rupturing, and it is primarily used in multiwall shipping sacks.

Multiwall shipping sacks are made of two or more plies of kraft paper, which can be combined with plies of plastic film or other barrier materials.

Typically, multiwall shipping sacks hold a minimum weight of 25 lb and are used to ship bulk products such as cement, chemicals, and agricultural products. Multiwall sacks provide a very economical packaging system. Because the layers of kraft paper and plastic film are lightweight, shipping costs are based mostly on product weight alone, and because the multiwall bag is flexible and strong, it can be stacked and pallet-loaded for shipment. Some smaller-sized multiwall bags are also used to package coffee, sugar, flour, pet food, and charcoal briquets for consumer markets.

Merchandise bags are specialized types of bags commonly used by department stores and other retail businesses. Typically, these bags are bleached and printed. Bleached kraft papers that are machine-finished (MF) or machine-glazed (MG) have an excellent glossy printing surface and are used when the appearance of bags or wrapping paper is important.

Wrapping and other converting grades include specialty papers that are often lightweight (25 lb or below) and coated or laminated for moisture, vapor, or grease resistance.

INDUSTRY STRUCTURE

The structure of the packaging and industrial converting industry is fragmented because of the wide range of grades produced. Commodity unbleached kraft bag and sack paper grades are mainly produced at integrated mills in the southeastern U.S., which may also produce kraft linerboard on the same paper machines. Some unbleached kraft paper is also produced in the Pacific Northwest and in western and eastern Canada.

The top three commodity producers of unbleached kraft papers are Stone Container Corp., Union Camp Corp., and Georgia-Pacific Corp. In the Pacific Northwest, Longview Fibre Co., Port Townsend Paper Co., and Simpson Paper Co. are the key producers. These companies also produce more specialized unbleached and bleached packaging and converting papers.

Specialty and industrial papers are manufactured at small, nonintegrated mills concentrated in the Northeast and upper Midwest. James River Corp. is the major producer of these grades. Other producers of specialty papers include P.H. Glatfelter Co., Mosinee Paper Corp., CPM Inc., Wausau Paper Mills Co., Filtration Sciences Corp., Hollingsworth & Vose Co., and Dexter Corp.

Negative growth rates and low profitability in the unbleached kraft paper segment have caused major industry restructuring through machine conversions and shutdowns and company divestitures. Stone has become the largest producer through its acquisitions of unbleached kraft mills formerly owned by Jacksonville Kraft Paper Co. and Continental Forest Industries Inc. Meanwhile, Champion International Corp., International Paper Co., and Georgia-Pacific have substantially reduced their market position by converting paper machines from bleached and unbleached kraft paper production to mostly kraft linerboard and uncoated free-sheet production.

In the specialty packaging and industrial paper sector, James River expanded significantly during the past decade by acquiring several small, nonintegrated specialty paper companies, including Riegel Products Corp. (1977), Brown Co. (1980), Premoid Corp. (1986), Specialty Paper Co. (1986), and Dunn Paper Co. (1987). James River also acquired specialty converting plants from H.P. Smith Paper Co. (1983) and Crown Zellerbach Corp. (1986).

Meanwhile, other companies sold or shut down their specialty paper businesses, including Bemis Corp. (1977-86), Port Huron Paper Corp. (1983), and Philip Morris Inc. (1985). Thilmany Pulp & Paper Co. shut down two of its specialty paper machines in 1987.

SUPPLY/DEMAND TRENDS

Production of packaging and industrial converting papers actually declined during the past ten years. Shipments increased slightly from 5.7 million tons in 1977 to a peak of 5.8 million tons in 1979, then declined to 5.1 million tons by 1988. This resulted in a negative annual growth rate of -1.2% during the period, compared with a 2.2% annual growth rate for all grades of paper and paperboard.

Most of the decline was in grocery bag and sack paper grades, which were displaced by plastic bags in about 50% of the country's supermarkets. Bleached packaging paper shipments held relatively steady, while multiwall shipping sack papers rebounded recently after a ten-year decline. The overall poor performance was blamed on competition from plastic films in many packaging markets and lackluster industrial activity during the early 1980s.

Although kraft packaging and industrial paper production dropped steadily, operating rates remained close to 90% because of planned capacity reductions. Most of the decline in capacity was concentrated in the unbleached kraft segment of the industry. This trend is expected to continue, but at a slower pace than in recent years. These scheduled capacity withdrawals, combined with modest

U.S. TOTAL PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

Year	Production	Capacity	Utilization rate (%)
1988	5,047	5,394	93.6%
1987	4,955	5,492	90.2
1986	5,117	5,758	88.9
1985	5,205	5,985	87.0
1984	5,551	5,991	92.6
1983	5,498	6,078	90.4
1982	5,300	6,076	87.2
1981	5,433	5,947	91.4
1980	5,327	6,072	87.7
1979	5,708	6,053	94.3
1978	5,778	6,146	94.0
1977	5,930	6,242	95.0
1976	5,661	6,202	91.3
1975	4,804	6,368	75.4
1974	5,732	6,360	90.1
1973	5,694	6,060	94.0
1972	5,706	6,028	94.7
1971	5,443	5,963	91.3
1970	5,438	5,940	91.6
1969	5,520	5,840	94.5

Source: American Paper Institute.

growth in production capacity for specialty papers, should keep average operating rates above 90% for the next several years.

KRAFT PACKAGING PAPERS

U.S. unbleached kraft paper shipments peaked at 4.0 million tons in 1974, and then plummeted to 2.8 million tons by 1988. Most of the decline occurred during the period of 1984-87, when shipments decreased nearly 680,000 tons. Grocery bag and sack grades suffered heavy losses, while multiwall sack grades had smaller losses.

In contrast, shipments of bleached packaging papers for the same end uses actually increased. In 1988, bleached kraft paper shipments reached 465,000 tons, compared with shipments of 381,000 tons in 1982.

In 1989, the American Paper Institute reclassified 275,000 tons of unbleached kraft paper and 75,000 tons of bleached kraft paper capacity as specialty grades. While the transfer did not affect the industry's total level of production, it did establish lower 1988 output levels for unbleached kraft papers (2.800 million tons) and bleached kraft papers (465,000 tons).

Shipments of unbleached kraft paper grades in 1989 are expected to be down approximately 5%. While the long-term decline in grocery bag and sack appears to have bottomed out, multiwall sack and converting grades are showing weakness.

Demand for bleached and multiwall grades, which was strong in 1988, is expected to be somewhat weaker in 1989. Operating rates should remain above 90%, however, as producers continue "rationalizing" capacity between heavyweight grocery sack paper, lightweight linerboard, and bleached grades.

Since 1984, the industry has shut down about 550,000 tons of unbleached kraft paper production capacity, and it has shifted another 300,000 tons to kraft linerboard production. In 1984-85, Georgia-Pacific shut down two machines at Crossett, Ark., with combined capacity of about 175,000 tpy, and it converted production to uncoated free-sheet and bleached kraft paper grades. G-P also converted a 158,000-tpy kraft paper machine at Monticello, Miss., to linerboard production in 1985. That same year, International Paper shut down a 135,000-tpy machine at Mobile, Ala., for conversion to uncoated free-sheet and bleached kraft paper grades. In 1986, Champion International shut down its 236,000-tpy swing machine at Pensacola, Fla., for conversion to uncoated free-sheet. In 1989, the company shut down another machine that produced about 110,000 tpy of bleached cupstock and kraft packaging papers, and it also plans to convert production to uncoated free-sheet. Additional conversions on a smaller scale were made during this

U.S. PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPER BY GRADES

(000 short tons)

	Unbleached kraft		Bleached kraft*		Special industrial paper	
Year	Production	Capacity	Production	Capacity	Production	Capacity
1988	2,800	2,872	1,061	1,112	1,186	1,275
1987r	2,839	3,032	952	1,025	1,163	1,250
1986r	3,116	3,376	946	1,028	1,056	1,148
1985r	3,246	3,632	941	1,045	1,017	1,131
1984r	3,520	3,795	955	1,038	1,111	1,263
1983r	3,505	3,860	937	1,157	1,053	1,171
1982r	3,413	3,792	822	1,068	963	1,284
1981r	3,569	3,679	828	975	854	1,206
1980r	3,653	3,805	876	1,095	523	977
1979	4,096	4,098	993	1,105	531	850
1978	3,998	4,223	1,043	1,041	498	883
1977	3,936	4,317	1,002	1,069	524	856
1976	3,918	4,218	1,138	1,128	574	856
1975	3,374	4,333	965	1,194	440	841
1974	4,169	4,389	1,205	1,291	598	679
1973	3,902	4,138	1,205	1,292	610	629
1972	3,811	4,083	1,272	1,323	507	622
1971	3,649	4,031	1,242	1,383	438	549
1970	3,786	4,007	1,231	1,316	421	554
1969	3,780	4,006	1,297	1,275	443	559

* = Includes glassine, greaseproof, and vegetable parchment.
r = Revised.

Sources: American Paper Institute, *Pulp & Paper* estimates.

period by other companies.

The most notable exception to this trend was Stone Container's reactivation of the former Jacksonville Kraft mill in 1987. Jacksonville's 125,000-tpy No. 1 machine currently produces 40- to 60-lb kraft sack and multiwall paper grades.

Grocery bag and sack is the single largest end-use market for unbleached kraft paper. Production of grocery bag and sack paper grew steadily during the first two decades after World War II, due to the rapid growth of supermarket chains and the increased demand for large carryout sacks. By the 1970s, however, shipments of grocery bag and sack began leveling off as population growth rates flattened and as plastic bags began displacing kraft paper. The introduction of plastic grocery bags signaled the end of kraft paper's dominance of the carryout sack market.

Plastic's share of the grocery sack market rose from about 2% in 1976 to about 30% in 1987, and it increased to an estimated 50% in 1989. Paper sacks lost market share simply because plastic sacks became more cost competitive. In 1976, a plastic sack was 110% of the cost of a paper sack. By 1980, the two products were at parity, and by 1987 the cost of a plastic sack was 60% that of a paper sack. Plastic's penetration may reach higher levels in the next few years; however, increasing criticism is being directed at all types of plastic packaging that adds to solid waste, including the plastic grocery sack.

Plastic sacks are more cost-competitive because of linear low-density (LLDPE) and high-molecular-weight high-density polyethylene (HMW-HDPE) resins, which permit converters to downgauge sacks and reduce raw material costs. The first plastic sacks developed a decade ago were more than 2.0 mil thick; today's sacks are in the range of 0.6 to 0.7 mil. (See Plastic Resins chapter.)

Competition between paper and plastic grocery sacks has had little dampening effect on kraft paper prices, because prices for grocery sack paper are influenced more by linerboard prices than by plastic bag prices. Because some swing machines in the industry can manufacture either heavyweight grocery sack paper or lightweight linerboard, producers allocate machine time according to which grade gives them a better return.

A 1988 industry survey found that an average of 70,000

ESTIMATED CAPACITY OF U.S. COMPANIES PRODUCING PACKAGING AND SPECIALTY PAPERS

Company	Annual capacity (000 short tons)	Grades
1. Stone Container[1]	773	Unbleached bag, sack, and converting
2. James River	535	Specialty packaging and industrial
3. Union Camp	450	Unbleached and bleached bag, sack, and converting and saturating kraft
4. Georgia-Pacific	340	Unbleached and bleached bag, sack, and converting
5. Longview Fibre	325	Unbleached and bleached bag, sack, and converting
6. Champion International	295	Unbleached and bleached bag, sack, and converting
7. Gaylord/Mid-America	270	Unbleached bag, sack, and converting
8. International Paper	260	Unbleached and bleached bag, sack, and converting
9. Gilman Paper	230	Unbleached and bleached bag, sack, and converting
10. Westvaco	200	Saturating kraft
11. Mosinee Paper	120	Specialty and industrial
12. Chesapeake	115	Unbleached bag, sack, and converting
13. Kimberly-Clark	115	Cigarette paper, specialty, and saturating kraft
14. Wausau Paper Mills[2]	105	Glassine, greaseproof, and specialty
15. Port Townsend	100	Unbleached bag, sack, and converting
16. P.H. Glatfelter[3]	90	Cigarette paper and technical specialty
17. Hammermill[4]	85	Specialty and industrial
18. Simpson Tacoma Kraft	80	Unbleached and bleached bag, sack, and converting
19. Fitchburg Paper[5]	70	Specialty and decorative
20. Willamette Industries	70	Unbleached bag, sack, and converting
21. Detroit River Paper[6]	60	Specialty and industrial
22. Consolidated Papers	55	Specialty packaging
23. Hollingsworth & Vose	50	Specialty and industrial
24. CPM	35	Specialty and industrial
25. Filtration Sciences	30	Specialty and industrial
26. Schoeller Technical	30	Photographic and technical specialty
27. Mead Specialty Paper	25	Technical specialty

Note: Exact capacities for packaging papers are difficult to estimate because of swing machines in the industry which can produce either linerboard or unbleached kraft packaging paper. Estimates for specialty and industrial papers are based on published sources and may not include some printing/writing paper, thin paper, or tissue tonnage.

1. Includes Seminole Kraft Corp.
2. Includes Rhinelander Paper Co.
3. Includes Ecusta Corp.
4. Includes Thilmany Paper Co. and Nicolet Paper Co.
5. Subsidiary of Rolland Inc. (Canada).
6. Purchased former Port Huron mill

tons of kraft paper was produced on swing machines each month, representing about 30% of total kraft paper production. For the same period, an average of 232,000 tons of linerboard was produced on swing machines each month, representing about 13% of industry production. In 1989, average monthly swing production figures were close to the 1988 levels.

Most of these machines make a better return when they produce lightweight liner in a strong linerboard market. This is because production costs are lower; therefore, kraft paper prices must remain competitive with linerboard prices in order to maximize mill profits. As a result, the price of 70-lb grocery sack paper increased about 18% in 1986 and 16% in 1987, while 26-lb linerboard prices increased about 18% in 1986 and 34% in 1987. In 1988, prices of 70-lb grocery sack paper reached the $455 to $465/ton level in the second quarter, and they climbed to between $495 and $505/ton in early 1989. The price of 26-lb linerboard increased to about $460/ton in early 1989.

Kraft paper price increases in 1986-87 were not fully recovered through equivalent price increases for converted grocery bags and sacks, so profitability of converting operations has been poor in recent years. Competition from plastic sacks and the concentrated purchasing power of major supermarket chains tend to keep price increases low for bags and sacks. Nevertheless, the gap between paper and plastic remains wide. In early 1988, heavyweight paper grocery sacks sold for $35 to $37/thousand, compared with $22 to $23/thousand for plastic grocery sacks. In 1989, kraft grocery sack prices increased to about $37 to $40/thousand, compared with $25/thousand for plastic grocery sacks.

Imported plastic grocery sacks sell for as low as $17 to $18/thousand. The poor profitability of converting operations will likely result in a smaller, more consolidated industry with fewer independent converters.

Plastic will continue to grow at the expense of paper in the grocery sack market, but its penetration rate will be lower than in the past. Plastic could reach 75% penetration by the mid-1990s. However, shipments of unbleached grocery bag and sack paper were expected to stabilize in 1989 at about 1.620 million tons.

Another sign of life in the grocery bag and sack business is the entry of a major new supplier. Gaylord Container Corp. purchased two grocery sack plants in 1989, and will supply these plants from its kraft paper mill at Pine Bluff, Ark. The acquisitions make Gaylord the second-largest integrated producer of grocery sacks (after Stone Container) with ability to serve markets in the eastern U.S.

Shipping sack is the second-largest end use for un-

U.S. PRODUCTION OF PACKAGING AND INDUSTRIAL CONVERTING PAPER—BY END USE[1]

(000 short tons)

Year	Wrapping paper			Shipping sack paper			Bag and other paper			Other converting		
	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]
1988	105	81	24	973	863	110	1,946	1,684	262	594	479	115
1987	112	88	24	883	785	98	2,023	1,769	254	538	431	107
1986	117	93	24	831	747	84	2,314	2,050	264	526	412	114
1985	124	93	31	876	796	80	2,386	2,120	266	576	398	178
1984	135	97	38	968	878	90	2,543	2,284	259	591	405	186
1983	147	101	46	967	879	88	2,529	2,289	240	606	397	209
1982	138	93	45	973	895	78	2,433	2,211	222	547	364	183
1981	183	103	80	1,085	967	118	2,188	2,012	176	516	340	176
1980	240	137	103	1,154	1,062	92	2,330	2,101	229	670	419	251
1979	306	187	119	1,212	1,110	102	2,365	2,115	250	786	499	287
1978	365	210	155	1,111	1,019	92	2,365	2,092	273	815	551	264
1977	354	218	136	1,180	1,073	107	2,516	2,212	304	794	558	236
1976	321	195	126	1,228	1,100	128	2,428	2,154	274	902	499	403
1975	280	165	115	974	879	95	2,166	1,938	228	752	417	335
1974	369	226	143	1,409	1,279	130	2,134	1,889	245	980	535	445
1973	425	267	158	1,176	1,072	104	2,196	1,942	254	1,057	599	458
1972	498	294	204	1,101	996	105	2,183	1,942	241	1,142	694	448
1971	491	285	206	1,078	976	102	2,146	1,911	235	1,084	591	493
1970	518	298	220	1,094	996	98	2,117	1,898	219	1,088	596	492
1969	574	345	229	1,123	1,023	100	2,018	1,791	227	1,146	621	525

1. Excludes glassine, greaseproof, and parchment papers and specialty industrial papers.
2. Principally bleached kraft papers.

Source: Bureau of the Census (1981-87 based on shipments; prior years are for production).

bleached kraft paper after grocery bag and sack. Shipments peaked at 1.0 million tpy in 1981. They averaged about 880,000 tpy in the 1982-84 period, and plummeted to 747,000 tons in 1986. In 1987, shipments rebounded to 785,000 tons, and they increased further to 840,000 tons in 1988. Shipments of bleached multiwall sack paper climbed from 98,000 tons in 1987 to 110,000 tons in 1988. Total multiwall paper shipments were expected to drop off in 1989 because of weaker demand for shipping sacks from agricultural, chemical, and construction industries.

Multiwall paper shipments were up sharply in 1987 and 1988 because of strength in those industries, where multiwall sacks are used for shipping fertilizer, animal feed, seed, cement, plastic resins, and other materials. The major competitive threat to shipping sacks is from bulk handling and heavy-duty plastic shipping sacks, which have penetrated about 10% of the U.S. market. Most multiwall sacks, however, already have a single barrier layer of polyethylene for moisture resistance and added strength.

A more significant reason for the decline in multiwall paper tonnage since 1981 is the reduction in the weight of paper used in multiwall sacks. The four basic weights of kraft paper—40, 50, 60, and 70 lb—have different tear and tensile strengths. It is a general rule that greater weight means greater strength, but tear and tensile properties of kraft paper have improved during the last decade, permit-

U.S. EXPORT AND IMPORT TRENDS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

Year	Exports[1]	Imports
1988	347	343
1987	294	310
1986	284	243
1985	244	172
1984	284	145
1983	261	108
1982	263	80
1981	303	94
1980	331	86
1979	227	143
1978	173	138
1976	356	56
1974	340	142
1972	183	148
1970	188	64

1. Includes special industrial paper and glassine, greaseproof, and parchment.

Sources: American Paper Institute, Bureau of the Census.

U.S. PRODUCTION OF UNBLEACHED KRAFT PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

				Bag and sack[2]			Other converting[3]				
Year	Total	Wrapping[1]	Shipping sack	Total	Grocer	Other	Total	Asphalting	Other creping	Gumming	Other
1988	3,107	81	863	1,684	1,610	74	479	—	—	—	—
1987	3,073	88	785	1,769	1,690	79	431	—	—	—	—
1986	3,302	93	747	2,050	1,960	90	412	—	—	—	—
1985	3,403	93	797	2,116	2,043	73	397	—	—	—	—
1984	3,683	97	883	2,292	2,203	89	411	—	—	—	—
1983	3,666	100	879	2,289	2,196	93	398	—	—	—	—
1982	3,563	93	895	2,211	2,127	84	364	—	—	—	—
1981	3,729	103	1,015	2,209	2,117	92	402	—	—	—	—
1980	3,852	137	1,062	2,269	2,168	101	384	176	40	63	105
1979	3,984	187	1,110	2,226	2,120	106	461	215	25	80	141
1978	3,900	211	1,019	2,225	2,121	104	445	173	22	61	189
1977	3,916	218	1,073	2,100	1,994	106	525	179	14	66	266
1976	3,815	195	1,100	2,106	1,966	140	414	167	6	68	173
1975	3,322	165	879	1,925	1,805	120	353	131	6	61	155
1974	4,079	226	1,279	2,131	1,974	156	443	134	13	83	213
1973	3,771	266	1,072	1,942	1,825	117	491	150	17	90	234
1972	3,825	294	996	1,942	1,854	88	593	165	25	96	307

1. All colored or natural brown MF and MG, including treated and untreated butcher papers.
2. Other than shipping sacks.
3. Data not available or withheld for 1981-88.

Sources: Bureau of the Census, American Paper Institute.

U.S. PRICE TRENDS FOR SELECTED UNBLEACHED KRAFT PAPER GRADES

($/short ton)

Year[1]	Shipping sack +50-lb	Grocery sack +70-lb	Grocery bag and sack +30-lb
1989			
2Q	$550/560	$495/505	$645/665
1Q	550/560	495/505	660/680
1988			
4Q	510/520	455/465	620/640
3Q	510/520	455/465	620/640
2Q	510/520	455/465	620/640
1Q	510/520	455/465	620/640
1987			
4Q	480/490	425/435	590/610
3Q	450/460	400/405	570/580
2Q	455	400	565
1Q	455	400	565
1986			
4Q	420/430	365/375	565
3Q	390	335/345	535
2Q	390	335/345	535
1Q	375/390	300/320	500
1985	375	288	441
1984	415	336	502
1983	395	250	—
1982	381	260	—
1981	401	305	—
1980	371	272	—
1979	328	243	—
1978	296	220	—
1977	288	199	—
1976	271	209	—
1975	266	220	—
1974	220	199	—

1. Annual average showed for years 1974 to 1985.
Source: *Pulp & Paper Pricebook2.*

ting substitution of lighter-weight paper. For example, during the drying process, MD strength of kraft paper can be substantially increased by compacting the sheet or by allowing the sheet to shrink. This extensible kraft paper can absorb more shock without rupturing than can conventional kraft paper.

An air-dried multiwall kraft paper with greater strength and stretch was introduced by St. Regis Paper Co. in 1982. This Stress Kraft paper permitted sack converters to eliminate a ply of paper for a basis-weight reduction of at least 18%, yet it performed as well as regular sack. Nevertheless, converters were unwilling to pay a premium price for Stress Kraft, and orders dried up during the country's economic downturn. Following Champion's takeover of St. Regis in 1984, production of Stress Kraft was phased out on the 240,000-tpy paper machine at Pensacola, Fla., by early 1986.

Normally, multiwall paper sells at a premium price because of its higher quality and strength properties. However, when multiwall paper prices move up rapidly, converters sometimes substitute sack plies with grocery paper. And when prices weaken for heavyweight grocery sack, some producers begin making multiwall paper.

Prices for 50-lb multiwall kraft paper increased about 11% in 1986 and 14% in 1987. During the second quarter of 1988, they reached $510 to $520/ton, and in 1989 they climbed to between $550 and $560/ton. Higher prices were paid for clay-coated or bleached multiwall paper. The price of 50-lb clay-coated bleached multiwall paper used in high-quality, printed bags reached $1,240 to $1,280/ton in 1989.

The long-term outlook for shipping sack paper shipments is more encouraging than it is for grocery bags and sacks. Total bleached and unbleached paper shipments increased about 6% in 1987 and 7% in 1988. Shipments will decline in 1989, owing to some market weakness and significant reductions of inventories. However, long-term growth will average between 1% and 2% annually.

Other bag and sack paper is used mainly for retail bags for bakery products, fast-food chains, and department stores. Losses in these markets appear to have bottomed out. Paper garment bags were largely displaced by plastics in the 1960s, and merchandise bags met heavy competition from plastics in the 1970s. With the introduction of low-cost, high-density polyethylene resins, plastic merchandise bags captured an estimated 75% of the market. However, a consumer backlash has recently developed against plastic bags that are not biodegradable or recyclable.

Paper suppliers have not yet given up on these markets that typically use lightweight kraft papers. Longview Fibre Co., a large supplier of lightweight

MAJOR U.S. UNBLEACHED KRAFT PAPER CAPACITY WITHDRAWALS

Completed	Mill	Capacity (short tpy)	Date
Gulf States Paper	Tuscaloosa, Ala.	167,000	1978
Crown Zellerbach	Bogalusa, La.	140,000	1979
Boise Southern	Elizabeth, La.	105,000	1981
Manville Forest	West Monroe, La.	35,000	1981
St. Regis	Lufkin, Texas	100,000	1981
Georgia-Pacific	Crossett, Ark.	175,000	1984-85
	Monticello, Miss.	158,000	1985
International Paper	Mobile, Ala.	135,000	1985
Champion International	Pensacola, Fla.	236,000	1986
Gilman Paper	St. Marys, Ga.	86,000	1988
Total withdrawals		1,337,000	

kraft packaging papers, plans to install a new 300-tpd lightweight bag and specialty kraft paper machine at its huge Longview, Wash., kraft mill. Scheduled for startup in late 1990, the $90-million project will permit Longview to produce a variety of lightweight grades that are in strong demand for bags and sacks, specialty packaging applications, and labels and release papers.

In 1989, lightweight 30-lb unbleached kraft bag paper sold for between $660 and $680/ton in the eastern U.S., but West Coast prices were slightly lower. Lightweight 30-lb bleached kraft bag paper sold for between $800 and $810/ton in 1989.

Demand has also been strong for the MF and MG papers that are used to produce specialty merchandise bags. Upscale department stores typically use heavier-weight, decorative paper merchandise bags to convey a quality image, and retail food stores often use lighter-weight, bleached coated paper bags for their sanitary appearance.

Wrapping paper has also lost much of its market share to plastic stretch and shrink films. Shipments of unbleached and bleached wrapping papers total about 100,000 tons annually. For the short term, demand is not expected to slip significantly, since most of the displacement has already occurred. Unbleached grades are mostly used for parcel post and industrial shipping, while the bleached grades are mostly used as butcher paper.

Other kraft converting papers, both unbleached and bleached, account for about 260,000 tons annually, and specialty packaging grades account for approximately 600,000 tpy. These grades were most affected by API's reclassification of specialty packaging and industrial grades. They are usually coated, waxed, gummed, or laminated for use as food liners, label face stock, and release liner basestock, among other applications.

The Consolidated Papers Inc. mill at Stevens Point, Wis., is the largest producer of these lightweight coated specialty grades. The mill's two machines produced about 56,000 tons in 1988, and the company is spending $110 million to install a new 160-tpd fourdrinier-type machine, with completion scheduled for late 1990.

Although demand for these papers declined in the 1970s as plastics claimed a large share of the flexible packaging market, the erosion has slackened in recent years. Converted grades that are in direct competition with plastic films

U.S. PRODUCTION OF MAINLY BLEACHED PACKAGING AND INDUSTRIAL CONVERTING PAPERS[1]

(000 short tons)

			Shipping sack[3]			Other bag and sack			Other converting[4]		
Year	Total[1]	Wrapping[2]	Total	Sulfite, kraft	Other	Total	Grocer	Other	Total	Waxing	Other[5]
1988	674	46	190	182	8	242	172	70	196	128	68
1987	663	46	178	168	10	214	153	61	225	147	78
1986	616	33	173	162	11	204	142	63	205	148	57
1985	570	33	118	107	11	240	170	70	178	130	48
1984	555	50	113	92	21	209	137	72	183	132	51
1983	561	65	119	95	24	168	122	46	209	157	52
1982	497	66	105	—	—	143	105	38	183	136	47
1981	536	80	117	84	34	176	124	51	167	120	47
1980	574	103	92	—	—	229	155	73	150	98	52
1979	643	119	102	—	—	250	170	80	172	113	59
1978	711	155	92	—	—	273	217	55	191	76	115
1977	716	136	107	—	—	304	198	106	169	69	100
1976	852	126	128	29	99	274	153	121	324	117	207
1975	629	115	95	27	68	228	133	95	191	97	94
1974	774	143	130	39	91	245	144	101	256	117	139
1973	786	158	104	22	82	254	169	85	270	138	132
1972	849	204	115	23	92	241	168	73	289	141	148

1. Excluding unbleached, glassine, greaseproof, and parchment papers. Principally bleached kraft paper, but can include sulfite and other-fiber-based papers.
2. Includes MG and MF wrapping papers and miscellaneous. MG/MF includes treated and untreated butcher papers.
MG/MF production: 1980, 95; 1979, 109; 1978, 127; 1977, 122; 1976, 109; 1975, 100; 1974, 121; 1973, 133; 1972, 171.
Misc. production: 1980, 8; 1979, 10; 1978, 28; 1977, 15; 1976, 17; 1975, 15; 1974, 22; 1973, 25; 1972, 33.
3. Includes combination kraft and rope, bleached and semibleached.
4. Over 18 lb. Production figures available in earlier years:
Envelope stock: 1976, 130; 1975, 99; 1974, 135; 1973, 130; 1972, 126.
Gumming stock: 1980, 32; 1979, 34; 1978, 23; 1977, 14; 1976, 12; 1975, 10; 1974, 11; 1973, 13; 1972, 13.
Twisting/spinning stock: 1974, 34; 1973, 35; 1972, 48.
5. Such as asphalting, creping stock, etc.

Sources: Bureau of the Census, *Pulp & Paper* estimates.

will continue to lose share gradually, but demand from other areas will support growth in specialty papers.

SPECIALTY INDUSTRIAL PAPERS

Specialty industrial papers represent a unique segment of the paper industry. More than 300 different specialty papers are produced for industrial customers in the U.S. and abroad. These papers are generally used by industry for conversion into other products, and they require the blending of various fibers and chemicals, and special surface treatment or lamination with synthetic films, textiles, or other materials. Often produced to exact customer specifications, industrial papers are used in the manufacture of automotive oil and air filters, cigarette papers, sanding belts and other abrasives, masking tapes, engine gaskets, electrical insulators, and pressure-sensitive release papers.

Production of specialty industrial papers has increased gradually since 1970, and currently totals about 1.186 million tons, according to API. However, because it is difficult to define these grades and to separate them from other converting grades, published capacity and production figures are not good indicators of industry trends. Some types of industrial papers have lost market share, especially in areas where plastic and synthetic products can substitute, such as nonwovens. Nonetheless, overall demand for specialty grades continues to expand, with pressure-sensitive release papers and filter papers performing best. In turn, pricing for most specialty grades remains strong. Some specialty paper sells for as high as $8/lb (or $16,000/ton) in the U.S.

Specialty papers are typically produced by small, privately held companies or divisions of larger paper companies, and mills usually have capacities ranging from 12 to 50 tpd. Most of these mills purchase pulp from outside sources, and may need as many as 10 to 20 different types of woodpulp, glass fibers, hemp fibers, and other materials to produce specialty papers. A mill often produces up to eight different grades of specialty paper per day on older machines with widths of 15 ft or less.

James River is by far the major North American producer of specialty industrial papers. Other notable producers include Filtration Sciences, C.H. Dexter, Mosinee Paper, Hollingsworth & Vose, Wausau Paper Mills, P.H. Glatfelter, CPM, Thilmany Pulp & Paper, and Georgia-Pacific. In

AVERAGE VALUE OF U.S. EXPORTS AND IMPORTS FOR PARCHMENT, GREASEPROOF PAPERS, AND GLASSINE

($/short ton)

Year	Exports	Imports
1988	$1,148	$1,551
1987	2,188	1,487
1986	2,385	1,374
1985	1,551	1,390
1984	1,625	1,416
1983	1,067	1,453
1982	1,330	1,498
1981	1,187	1,686
1980	1,148	1,578
1979	1,008	1,020
1978	833	948
1977	807	879
1976	739	849
1975	445	872
1974	655	731
1973	651	616
1972	812	581
1971	727	417
1970	671	417

Source: Dept. of Commerce.

PRODUCERS OF VEGETABLE PARCHMENT, GLASSINE, AND GREASEPROOF PAPERS

Company	Location	Grades	Capacity[1] (tpd)
1. James River Corp.			
Riegel Products Div.	Milford, N.J.	Glassine, greaseproof	100
KVP/Dunn Paper Div.	Parchment, Mich.	Vegetable parchment	120
2. Wausau Paper Mills Co.			
Rhinelander Paper Co.	Rhinelander, Wis.	Glassine, greaseproof	150
3. Hammermill Paper Co.			
Nicolet Paper Co.	De Pere, Wis.	Glassine, greaseproof	140
4. E.B. Eddy Forest Products	Espanola, Ont.	Vegetable parchment, greaseproof	140
5. Simkins Industries			
Westfield River Paper Co.	Lee, Mass.	Glassine, greaseproof	15
	Russell, Mass.	Glassine, g[illegible]proof	50
Deerfield Specialty	Nixon, Ga.	Glassine, greaseproof	55
	Quebec, Que.[2]	Glassine, greaseproof	35
6. Domtar Inc.	St. Catherines, Ont.	Glassine, greaseproof, vegetable parchment	70

1. Capacity estimates may include tonnage of other specialty grades.
2. Subsidiary is Glassine Canada Inc.

1989, European specialty papermaker A. Ahlstrom Corp. acquired Filtration Sciences, the leading U.S. manufacturer of automotive filter papers. Also in 1989, the Kapaco Group acquired specialty papermaker Watervliet Paper Co.; James River acquired the Wyomissing specialty paper division of Paper Corp. of America; and Mead Corp. sold its silicone-coated release liners business to Rexham Industries Inc. In 1988, Portals Papermaking Ltd. sold its Hawkinsville, Ga., paper mill to Hollingsworth & Vose.

Saturating kraft paper is a unique, growing segment of the specialty industrial area. It is used to make decorative laminates such as Formica countertops, and it is also used to manufacture saturated waterproof papers for construction purposes. Although cyclical, demand for saturating kraft has had long-term, positive growth, with 1988 production estimated at 300,000 to 350,000 tons. The two major producers of saturating kraft are Westvaco Corp.'s Charleston, S.C., mill and Union Camp's Savannah, Ga., mill. In 1984, Union Camp completed a $27-million improvement on its saturating kraft paper machine, and in 1987, Westvaco rebuilt a saturating kraft paper machine to increase capacity. Ivex Corp. also produces waterproof saturated papers at its Joliet, Ill., mill.

GLASSINE/VEGETABLE PARCHMENT/GREASEPROOF

Glassine papers have smooth, glass-like surfaces and are transparent. They are mostly used for protective food and nonfood packaging, but other applications include drafting and graphic papers and envelope windows.

Sulfite pulp is beaten and refined to such a high degree that the pulp appears to be a dense, gelatinous mass. The high degree of fiber damage and collapse that occurs during pulping increases the fiber bonding area and makes glassine highly resistant to the passage of vapors, oils, and grease. When waxed, lacquered, or laminated, the paper is also impervious to moisture. Glassine is formed on a fourdrinier paper machine and is supercalendered to give the sheet a high gloss. Typical basis weights range from 15 to 40 lb (24 x 36 in., 500 sheets).

Vegetable parchment gets its name from its physical similarity to animal parchment. It is prepared by passing a sheet of cotton-fiber or chemical-woodpulp paper through a bath of sulfuric acid, followed by washing and drying. The resulting sheet has a "parchment" feel and appearance, and it is very durable and resistant to grease and other contaminants. The sheet has high wet strength, and it may be waxed, coated, embossed, or crinkled. As a printing paper, it is a high-quality sheet used for legal documents. Basis weights range from 24 to 40 lb. (17 x 22 in., 500 sheets).

For packaging purposes, vegetable parchment and greaseproof papers have various weights and degrees of translucency or opaqueness. They are used to wrap frozen, moist, greasy, or dry food products such as butter, meat, and poultry. Like cellophane and waxed papers, they have lost many of their traditional markets to plastic films. In 1980, production of these papers was reported by the Bureau of the Census to be about 200,000 tons. The figure may be half of that amount today. James River, Nicolet Paper Co., and Simkins Industries Inc. in the U.S., and E.B. Eddy Forest Products Ltd. in Canada are the industry's remaining principal producers.

CANADIAN KRAFT PAPER INDUSTRY

The Canadian kraft paper industry has many of the same market conditions for its products as the U.S. industry. Domestic kraft paper consumption has gradually declined as plastic products have replaced paper bags and sacks in traditional end-use markets. However, Canadian producers have offset these losses by increasing their export shipments of kraft paper to the U.S. and overseas markets, particularly for high-strength multiwall grades.

Production of bleached and unbleached kraft papers gradually declined from a cyclical peak of 637,000 metric tons in 1978 to 430,000 tons in 1984. By 1987, production had rebounded to 567,000 tons. Operating rates also improved from a low of 77.4% in 1984 to a strong 97.1% in 1987. Production levels in 1988 were virtually equal to 1987 levels.

The decline in domestic consumption of kraft papers has mostly affected eastern Canadian mills, which were built to serve the domestic market and are not particularly cost competitive. Companies that have dropped out of the kraft paper business were concentrated in the east, and include Great Lakes Forest Products Ltd., CIP Inc., Abitibi-Price

U.S. PRODUCTION, EXPORTS, AND IMPORTS OF PARCHMENT, GREASEPROOF PAPERS, AND GLASSINE

(000 short tons)

Year	Production	Exports	Imports
1988	—	32	24
1987	—	6	23
1986	—	4	17
1985	—	6	16
1984	—	5	12
1983	209	17	8
1982	206	5	6
1981	176	9	5
1980	202	8	4
1979	234	8	5
1978	259	8	5
1977	219	5	3
1976	207	10	3
1975	191	11	2
1974	240	8	3
1973	230	4	3
1972	234	3	2
1971	206	3	2
1970	203	3	3
1969	216	—	—

Source: Bureau of the Census.

CANADIAN PRODUCTION AND CAPACITY FOR KRAFT PAPERS

(000 metric tons)

Year	Production	Capacity	Utilization rate (%)
1988	568	584	97.3%
1987	567	586	96.7
1986	540	579	93.3
1985	486	541	89.8
1984	430	531	81.0
1983	475	554	85.7
1982	453	527	86.0
1981	516	566	91.2
1980	538	562	95.7
1979	606	617	98.2
1978	637	622	102.4
1977	546	621	87.9
1976	518	624	83.0
1975	422	641	65.8
1974	637	636	100.2
1973	616	602	102.3
1972	537	570	94.2
1971	492	—	—
1970	439	—	—
1969	451	—	—

Source: Canadian Pulp & Paper Assn.

Co., and Consolidated-Bathhurst Inc. The western Canadian industry, on the other hand, is highly export-oriented and includes large, efficient mills operated by Canfor Corp., Eurocan Pulp & Paper Co. Ltd., and Manfor Ltd. All of these companies have constructed new mills during the past ten years with capacities in excess of 100,000 metric tpy.

In 1989, the most significant development in this sector was the sale of Manfor Ltd., formerly owned by the Manitoba government, to Repap Enterprises Corp. Repap plans to convert the kraft pulp and paper mill's production from ~~400~~ metric tpd of high-strength kraft sack paper to 500 metric tpd of bleached kraft pulp. In a second stage, Repap plans to construct a world-class, 1,200 metric-tpd softwood bleached kraft pulp mill at the facility.

Domestic paper shipments have remained at about 240,000 metric tpy during the past five years. Plastics have captured about 60% of the Canadian grocery bag and sack market and about 40% of the shipping sack market. Although this market penetration is very uneven throughout the country, it is generally conceded that market losses will continue, albeit at a slower rate.

Exports of kraft paper have increased steadily from about 192,000 metric tons in 1984 to 340,000 metric tons in 1988. Approximately 50% of kraft paper exports are destined for the U.S. market, and nearly 100% of converted kraft paper bag and sack exports go to the U.S. Multiwall kraft paper and shipping sacks account for most of the export activity.

ESTIMATED CAPACITY OF CANADIAN COMPANIES FOR KRAFT AND SPECIALTY PAPERS

(000 metric tons)

Company	Annual capacity[1]	Grades
Eurocan Pulp & Paper Co.	130	Unbleached bag, sack, wrapping
Manfor Corp.	140	Unbleached bag, sack
Prince George Pulp & Paper	110	Bleached and unbleached sack, bag
Cascades Inc.	80	Unbleached and bleached bag, wrapping
Crown Forest Industries Ltd.	45	Bag, wrapping, converting
Eddy Forest Products Ltd.	45	Bleached bag, sack, converting, wrapping
Domtar Inc.	30	Bleached and unbleached bag, sack, converting, wrapping
J. Ford & Co. Ltd.	6	Kraft wrapping and specialty paper

1. Consolidated-Bathurst shut down a 35,000-metric-tpy kraft paper machine in 1988.

Paper:

TISSUE

Tissue falls into two major groups: sanitary and "other." About 98% of total output is sanitary, including bathroom, facial, toweling, napkins, basestock for sanitary stock, wadding, and wipes. The "other" group includes basestock for waxing, wrapping, and miscellaneous uses.

The two major markets for tissue are consumer and commercial and industrial (c&i). Consumer tissue is purchased by consumers at retail outlets, while industrial tissue is bought by hotels, offices, restaurants, factories, and institutions. Typical tissue basis weights include 12 to 14 lb/3,000 ft² for single-ply bathroom tissue and 32 to 39 lb/3,000 ft² for single-ply toweling.

OUTLOOK

Tissue demand in the U.S. is expected to decrease as population growth slows down, but industry sources predict that per capita tissue consumption will increase from 38.5 lb to 45.2 in the next decade.

Since the 1988 edition of *Factbook*, the American Paper Institute has revised downward the capacity of the U.S. tissue industry. This means that the U.S. industry ran at about 97% of capacity in 1988 and is expected to run close to 98% in 1989, barring the beginning of a recession. API reviewed most of the tissue machines in the U.S. and concluded that capacity had previously been overstated because of assumptions made about the different tissue grades being produced. The revised capacity figures (000 short tpy) are: 1987, 5,505; 1988, 5,626; 1989, 5,757; 1990, 5,946; and 1991, 6,096.

The survey revealed that of the 5.505 million tons of tissue made in 1987, 2.266 million tons were integrated and 3.239 million tons were unintegrated with pulp mills. The total number of tissue machines in the U.S. in 1987 was estimated by API to be 209 units. The survey sample included 165 units because no statistics were available for the remaining 44 machines.

Fort Howard Corp. is indisputably the leader in the c&i market. The company went private during the summer of 1988 in a leveraged buyout financed by the investment firm of Morgan Stanley. This generated a debt load that caused Fort Howard to postpone some of its capacity expansion plans. The company also decided to sell off its cup and plate business, which had worldwide sales of about $925 million in 1988, to a private investor group for an undisclosed amount. This helped pay off some of the debt from the $3.9-billion buyout, and it will enable Fort Howard to bring on some new capacity. In July 1989, the company said it will add a fourth recycled tissue machine at its Savannah River mill in Rincon, Ga., to start up in mid-1991. It also said it will seek permits to expand its three-machine tissue mill at Muskogee, Okla., and its mill at Green Bay, Wis., which has several older tissue machines.

Producers of away-from-home tissue products imple-

U.S. STATISTICS FOR TISSUE

	1989e	1988	1987
Production, 000 tons*	5,629	5,476	5,301
Capacity¹	5,757	5,626	5,505
Utilization rate, %	97.7	97.3	96.3
Imports²	50	59	66
Exports²	17	41	17
Apparent U.S. consumption	5,662	5,494	5,350
lb/capita	46.1	44.8	43.6
GNP ratio (000 tons/ $ billion real GNP)	2.77	2.75	2.78

e = Estimate.
* All tons are short tons.
1. American Paper Institute data.
2. U.S. Dept. of Commerce data.

mented two price increases during 1988: a 4% to 7% hike in March and a 7% hike in October. This pattern mirrored increases that were implemented in 1987. The hikes were somewhat successful because demand was strong, and tissue makers needed to pass on the rising cost of wastepaper and especially of market pulp. However, no hike was implemented in the spring of 1989, and some merchants surveyed said that several mills offered discounts during the year, reflecting a slowdown in the economy.

Although producers of consumer tissue have also suffered from rising market pulp prices, they have been less successful in passing on these costs to consumers due to the highly competitive nature of their market. In late March 1988, James River Corp. announced it was leading an across-the-board price increase on consumer tissue products. Effective Apr. 1, 1988, the price of the company's toilet tissue rose 9.2%, towel prices increased 5.6%, and the price of napkins rose 5.0%. Prior to this, no major player in the consumer market had hiked prices on roll products in about seven years.

In November 1988, Scott Paper Co. led a price hike of 5% to 8% on consumer towel and napkins, with the average being closer to 7%. The other big producers, James River and Procter & Gamble Co., joined the attempt. Scott is the leading producer in both areas, and it is second to P&G in the toilet tissue market. In January 1989, P&G led an 8% to 9.8% price increase on bathroom tissue, and in mid-1989 Scott implemented a 6.5% increase on its value-brand toilet tissue, ScotTissue.

Since Scott sold its share in Brunswick Pulp & Paper Co. in mid-1988, all of the U.S. consumer tissue producers except Georgia-Pacific Corp. are net buyers of pulp. Scott is reportedly buying about 14% of its pulp on the market. In addition, both Scott and Kimberly-Clark Corp. have unintegrated tissue mills offshore, which were vulnerable to pulp prices as high as $800/metric ton, depending on the exchange rate.

Consumer-tissue producers have their backs to the wall because consumers will no longer tolerate big reductions in sheet counts, so a successful price increase is the only way for them to pass on rising market pulp prices.

During the hiatus in which no price increases were an-

U.S. SHIPMENTS AND CAPACITY OF TISSUE PAPER

(000 short tons)

Year	Production[1]	Change (%)	Capacity[2]	Change (%)
1991p	—	—	6,096	2.5%
1990p	5,625	0.8%	5,946	3.3
1989p	5,578	1.8	5,757	2.3
1988	5,476	3.3	5,626	2.3
1987	5,301	4.0	5,505	-0.6
1986	5,095	3.1	5,472	2.4
1985	4,941	0.4	5,345	1.3
1984	4,921	2.7	5,276	1.7
1983	4,792	7.9	5,190	1.3
1982	4,441	-1.7	5,125	1.8
1981	4,517	3.2	5,033	1.6
1980	4,375	-3.2	4,954	1.7
1979	4,521	7.3	4,870	4.8
1978	4,215	-1.6	4,644	2.1
1977	4,285	2.4	4,545	1.0
1976	4,184	5.2	4,500	1.5
1975	3,979	-2.6	4,432	2.5
1974	4,086	1.2	4,322	0.4
1973	4,039	1.6	4,303	-0.3
1972	3,977	3.8	4,318	1.7
1971	3,833	3.1	4,244	1.4
1970	3,718	3.0	4,185	8.1
1969	3,611	—	3,873	—
Average 1978-88		2.5		2.4

p = Preliminary.
1. Source: Bureau of the Census.
2. Source: American Paper Institute.

CANADIAN PRODUCTION AND CAPACITY FOR TISSUE AND SANITARY PAPERS

(000 short tons)

Year	Production[1]	Capacity Sanitary papers	Capacity Other tissue
1991e	—	676	21
1990e	—	648	20
1989e	—	578	20
1988	500	548	20
1987	466	535	21
1986	495	516	20
1985	476	509	20
1984	424	514	20
1983	411	495	20
1982	413	500	21
1981	430	474	21
1980	406	414	23
1979	399	401	23
1978	368	403	24
1977	342	404	22
1976	335	385	25
1975	283	372	28
1974	361	353	27
1973	324	349	23
1972	312	344	20
1971	289	—	—
1970	240	—	—
1969	281	—	—

e = Estimate.
1. Excludes special papers.

Source: Canadian Pulp & Paper Assn.

nounced on roll products, producers instituted de facto price hikes by reducing sheet counts or basis weights. One source estimated that consumer tissue producers have on average reduced sheet counts in bathroom tissue from 420 sheets in 1981 to about 280 in 1987—a 33% reduction. This translates into an annual price increase of at least 7%. Short-sheeting was in abatement during most of 1988, but in early 1989, P&G dropped its jumbo towels to 67 ft^2.

A.C. Nielsen Marketing Research reported that total U.S. sales of toilet tissue in grocery stores amounted to $1.91 billion for the year ending July 1, 1989—an increase of 9.1% from the same period a year earlier. Sales of paper towels amounted to $1.22 billion, a 7.0% rise. Facial tissue sales of $692 million improved 4.1% from 1987.

EXPANSION PLANS

At Scott's 1989 annual meeting, the company revealed that it was running short of tissue capacity in the U.S. and that it was looking at ways to expand. K-C is in the process of building two greenfield tissue mills in the U.S.—one for C&I tissue in Loudon, Tenn., and a 68,000-short-tpy mill in Jenks, Okla. James River started up a new 80,000-tpy unit in October 1988 at its Clatskanie, Ore., mill. It has yet to reveal the location of the other two tissue machines it says it will start up between 1989 and 1994.

Several larger tissue machines slated to come online during 1989-90 will use 100% recycled fiber. These include a 70,000-tpy unit at FSC Paper, Alsip, Ill.; a third machine at Fort Howard's Rincon, Ga., mill; Atlantic Packaging Products Ltd.'s 43,000-tpy unit in Whitby, Ont.; and Wisconsin Tissue Co.'s 80,000-tpy machine in Menasha, Wis. The tissue companies are among the leaders in turning wastepaper into good-quality tissue, although they are very cagey about revealing any details of their systems. Fort Howard has a reputation for being able to make tissue out of practically any low-grade wastepaper. K-C is running a pilot plant near its tissue mill in Memphis, Tenn., in order to experiment with a new system for removing laser print from computer printout paper.

Because of renewed public interest in recycling programs, these mills could find some inexpensive office waste coming their way. Plus, they have not been subjected to soaring market pulp prices as have mills that use pulp to make tissue. For example, most tissue mills on the West Coast use pulp instead of wastepaper.

In Canada, Scott Paper Ltd. increased its market dominance by buying the White Swan Div. of E.B. Eddy Forest Products Ltd. in early 1989 for C$110 million. Scott is also expanding the deinking system at its Crabtree, Que., mill, which is running at capacity, and it is adding a 300-metric-tpd bleached chemi-thermomechanical pulp (BCTMP) mill there. The BCTMP mill will start up in 1992 and cost C$110 million.

An interesting development in Canada is Cascades Inc.'s announcement that it will begin selling "environmentally friendly" tissue products in fall 1989. This includes toilet tissue, adult disposable diapers, and sanitary napkins that will be made from BCTMP, not chlorine-bleached pulp. In the fourth quarter of 1989, the company will start up an 80-metric-tpd machine to make the tissue paper. It began selling the other products earlier in the year. While such environmentally friendly products have made inroads in Europe and Scandinavia, Cascades is the first major North American paper company to offer them.

In 1989, K-C fired its salvo in the three-way race with James River and Scott for best position in the European Community in anticipation of the 1992 single market. The companies are also racing against time in another sense. Demand growth rates of about 4% to 5% in recent years are expected to decline to between 2% and 3% by 1994, according to a report by the European Tissue Symposium.

Per capita tissue consumption in Europe averaged 8.8 kg in 1988. The biggest growth potential is found in southern

U.S. SHIPMENTS OF TISSUE PAPER, EXCLUDING SANITARY AND THIN PAPER

(000 short tons)

Year	Total tissue paper[1]	Wrapping tissue	Waxing tissue stock	Twisting tissue stock	Creped wadding[2]	Other tissue paper
1988	166	78	(D)	—	(D)	37
1987	145	69	(D)	—	(D)	28
1986	130	59	(D)	—	(D)	23
1985	126	56	(D)	—	(D)	23
1984	136	69	(D)	—	(D)	31
1983	110	(D)	(D)	—	(D)	20
1982	106	(D)	(D)	—	(D)	21
1981	114	(D)	(D)	—	(D)	25
1980	176	72	24	13	25	18
1979	198	63	31	14	41	21
1978	210	74	32	12	37	29
1977	197	74	28	9	35	28
1976	193	61	37	8	30	30
1975	178	47	39	7	34	22
1974	224	44	49	10	46	41

(D) = Data withheld to avoid disclosing figures for individual companies.
1. Excluding sanitary and thin.
2. Creped wadding for interior padding.

Source: Bureau of the Census.

Europe. For example, Sweden has the highest per capita consumption at 18.7 kg, while Portugal's is the lowest at under 4 kg. Spain, with a population about four times larger than neighboring Portugal, has a consumption rate of about 4.8 kg. The big consumers are Denmark, 13.1 kg; Finland, 12.2 kg; Norway, 13.0 kg; Fed. Rep. Germany, 11.5 kg; and Switzerland, 11.2 kg.

The net tonnage of tissue consumed by all 16 countries in western Europe grew by 133,000 metric tons in 1988 to a total of 3.15 million tons—a 4.4% increase from 1987. Toilet tissue accounted for about 52.5% of tissue consumption in Europe vs about 45% in the U.S. Tissue mills in Europe operated at about 95% of capacity in 1988.

K-C is building two mills in Flint, North Wales, to make tissue for the c&i market. It will also build a 68,000-metric-tpy greenfield mill near Villey Saint-Étienne in northeastern France to make consumer tissue. The latter will start up in mid-1991. A converting operation may start up in 1991.

Scott said it will build three greenfield tissue mills in France, Spain, and Italy as part of a $250-million European investment that it announced in 1987. James River/Kaysersberg is starting up a 90-metric-tpd Beloit tissue machine at the mill in Gien, France, in early 1990. James River also acquired a 50% share in Spanish tissue company Sarrió Cia. Papelera de Leiza SA in early 1989.

In mid-1989, James River and Gruppo Ferruzzi of Italy joined with Nokia Corp. of Finland to form a strategic alliance in Europe that will include James River-Ferruzzi's tissue interests in Spain and Nokia's existing mills. This means James River will have joint ventures in France, Spain, Italy, Turkey, Finland, and the U.K.

Another major consolidation in the European tissue market was announced in April 1989 when Metsä-Serla Oy of Finland agreed to purchase Mo Och Domsjö AB's Holmen Hygiene unit for about $205 million. The transaction is expected to be completed by the end of 1989. It will lift Metsä-Serla's tissue capacity to about 230,000 metric tpy, making it the biggest European tissue producer.

While the major U.S. tissue companies have made no secret of the fact that their focus is on Europe, they have also been exploring markets where growth potential as well as risk are greater. For example, James River acquired Ipek Kagit AS of Turkey in early 1989. Scott announced in late 1988 that it would spend $50 million over the next two years on new paper machines, rebuilds of several others, converting plants, and other equipment to expand its tissue business in Asia. That includes projects in Taiwan, Malaysia, and Thailand. K-C started up a new 17,000-tpy tissue machine in Rep. Korea in early 1989, and it plans to start up another by the end of 1989.

Scott is also seeking to secure woodpulp supplies abroad. It is involved in a joint venture to build a bleached kraft eucalyptus pulp mill in Chile, and the company is studying construction of a 1,000-tpd eucalyptus pulp mill in Indonesia that could start up in the late 1990s. Scott said it decided to sell its share in Brunswick Pulp & Paper because

U.S. SHIPMENTS OF SANITARY TISSUE

(000 short tons)

Year	Total sanitary paper	Toilet tissue			Facial tissue	Napkin			Toweling[1]	Sanitary napkin wadding	Wiper stock[2]	Other sanitary stock
		Total	Single-ply	Multi-ply		Total	Single-ply	Multi-ply				
1988	4,906	1,853	1,109	744	323	675	488	187	1,729	(D)	186	141
1987	4,740	1,798	1,077	721	301	623	432	194	1,715	(D)	178	122
1986	4,638	1,809	1,127	681	303	595	431	165	1,644	(D)	156	131
1985	4,494	1,833	1,198	635	302	596	451	144	1,521	(D)	111	131
1984	3,953	1,489	955	534	285	529	400	128	1,363	73	108	104
1983	4,337	1,742	941	802	292	594	467	127	1,449	99	60	99
1982	4,185	1,679	962	717	277	532	407	125	1,433	113	56	94
1981	3,917	1,533	944	588	298	474	341	133	1,253	116	129	114
1980	4,298	1,706	939	766	370	532	409	123	1,439	—	251	—
1979	4,403	1,772	978	794	376	533	404	129	1,482	86	240	—
1978	4,036	1,629	939	690	383	429	317	116	1,376	73	57	76
1977	4,045	1,605	877	729	365	370	353	117	1,388	73	48	96
1976	3,936	1,578	933	645	359	448	342	106	1,335	53	52	90
1975	3,669	1,422	828	594	374	436	334	102	1,230	69	62	89
1974	3,799	1,415	834	581	395	439	345	93	1,308	—	55	119

(D) = Data withheld to avoid disclosing figures for individual companies.

[1] Excludes wiper stock but includes facial tissue stock for towels.

[2] Regular, facial, and wadding type.

Source: Bureau of the Census, "Current Industrial Reports Series M26A."

it wants to focus on fibers like eucalyptus, northern softwood kraft, and recycled fiber—none of which Brunswick produced.

MARKETS

Sanitary tissue represents about 98% of the tissue industry, and toilet tissue and toweling each make up about a third of the total sanitary and nonsanitary tissue market. These and other sanitary tissue products are converted by the paper manufacturer and sold as finished goods in cases. Very little tonnage is sold as parent rolls to the nonpapermaking converters that make them into finished products.

Most consumer tissue products are sold under brand names of major companies, with the most significant players being P&G, K-C, Scott, James River, Georgia-Pacific, Johnson & Johnson Corp., and Tambrands Inc. Branded products represent about 75% to 80% of retail tissue sales, with the rest being "generic" and "private label"—mainly store brands.

Producers of branded tissue are focusing on high-value products that they believe will bring the best return. In spring 1987, G-P introduced the first premium branded tissue to debut in the U.S. in over ten years. Extensive consumer research conducted by G-P prior to the product launch found that U.S. consumers prefer premium tissue, and these products account for about two-thirds of the $2.2-billion branded tissue market. P&G's Charmin, the leading U.S. brand, holds about a 22% share of the total category. Scott's four brands—Cottonelle, ScotTissue, Soft 'n' Pretty, and Waldorf—have a combined share of 23%, according to *Advertising Age* magazine.

More recent entries in this high-value segment include Scott's Hypo-Allergenic Cottonelle toilet tissue. The product was introduced in late 1988 and will compete with P&G's Charmin Free, introduced in 1986.

Private-label tissue continues to gain market share at the expense of generic tissue, and private-label napkins outsell all of the national brands. Retailers of private-label paper products such as toilet tissue, napkins, and towels have had to hunt for sources of supply because James River and Scott have withdrawn from the market and because G-P has drastically cut back.

A survey of 51,000 retailers conducted in February 1989 by *Private Label* magazine noted that retailers frequently use branded paper products as loss leaders and rely on private-label products as their main profit makers in the paper sector. Private-label paper products now account for about 25% of category unit volume and for 15% of dollar volume, the magazine said. Sales of private-label paper products rose 7.5% in 1989, according to the magazine. Store brands with the biggest growth were nine-roll packs of toilet tissue, 500-count napkins, and 250- to 280-count facial tissue, indicating that consumers want more value for their money.

The C&I tissue sector has been restructured as a result of James River's purchase of Crown Zellerbach Corp. In the C&I tissue sector, Fort Howard ranks first with 31% of the 1.6-million-tpy market, followed by James River with 26%

NORTH AMERICAN TISSUE EXPANSIONS

Startup	Company	Mill	Annual capacity (short tons)
Announced			
Apr. 1987	Fort Howard	Rincon, Ga.	88,250
Feb. 1988	Georgia-Pacific	Palatka, Fla.	35,000[1]
Apr. 1988	Fort Howard	Rincon, Ga.	88,250
Oct. 1988	James River	Clatskanie, Ore.	70,000
Late 1988	Tagsons Papers	Mechanicville, N.Y.	n.a.
Apr. 1989	Fort Howard	Green Bay, Wis.	n.a.
Aug. 1989	Fort Howard	Rincon, Ga.	88,000
Sept. 1989	Vicell Canada	Delta, B.C.	9,000
Oct. 1989	Atlantic Packaging	Whitby, Ont.	43,000
Oct. 1989	Irving Tissue	St. John, N.B.	75,000
Oct. 1989	FSC Paper	Alsip, Ill.	70,000
Dec. 1989	Atlas Paper Mills	Hialeah, Fla.	14,000
Late 1989	Cascades	Kingsey Falls, Que.	31,300
Mid-1990	Wisconsin Tissue	Menasha, Wis.	80,000
Late 1990	Kimberly-Clark	Loudon, Tenn.	34,000
1990	Kimberly-Clark	Jenks, Okla.	68,000
Mid-1991	Fort Howard	Rincon, Ga.	88,000
1991	Perkins Papers	Candiac, Que.	28,000
Proposed			
n.a.	American Tissue	Natchez, Miss.	n.a.[2]
n.a.	James River	n.a.	n.a.[3]
n.a.	Potlatch	Lewiston, Idaho	n.a.[4]
n.a.	Fort Howard	n.a.	n.a.[5]

n.a. = Not available.
1. Incremental capacity expansion from rebuild.
2. Conversion of Diamond International Corp.'s idle molded pulp mill.
3. James River will start up two tissue machines between 1989 and 1994.
4. Studying rebuild of machine.
5. Fort Howard is seeking permits to expand its mills at Green Bay, Wis., and Muskogee, Okla.

Source: *Pulp & Paper Week*.

U.S. MARKET INDICATORS FOR TISSUE PRODUCTS

(billion units)

Year	Facial tissue (two-ply)	Disposable household towels (jumbo rolls)	Bathroom tissue (rolls)
1988	196	2.6	9.6
1987	196	2.5	9.1
1986	194	2.4	8.7
1985	190	2.4	8.6
1984	191	2.3	8.1
1983	190	2.2	7.7
1982	188	1.9	6.9
1981	183	1.8	6.6
1980	179	1.8	6.7
1979	181	1.7	6.6
1978	181	1.6	6.5
1977	180	1.5	6.3
1976	182	1.5	5.8
1975	177	1.4	5.3

Source: Kimberly-Clark Corp.

and Scott with about 9%. The dominant consumer grade is bathroom tissue, but in the C&I sector, toweling is the big commodity.

Other tissue grades include a small but important group of specialty grades used for wrapping, cushioning, packaging, and packing. Wrapping paper is the most significant grade in this category. Producers of these grades typically use small, old machines on which they can also make industrial wipes, but they cannot compete in consumer tissue markets. As specialty tissue makers, they can often operate profitably within a narrow niche as long as they can pass along increased raw material and manufacturing costs.

TECHNICAL DEVELOPMENTS

Basically, two types of sanitary tissue are offered: high-priced, high-performance products and lower-priced, conventional sheets. The high-priced category is made using low-density forming techniques that yield substantial reductions in fiber costs per case of tissue. Low-density forming avoids conventional pressing to retain fiber quality and texture, increasing the load on the dryers; therefore, the reduction in fiber costs is offset by increased energy costs.

A generic description of today's tissue machine includes hydraulic headbox; twin-wire former with plain or suction forming roll; single-felt, double-roll press section with suction shoe pickup and Z-felt return run; 18-ft-dia ribbed yankee dryer; moisture profile control device; three yankee doctors with conforming type crepe doctor; on-machine calender; stabilizer foil sheet supports; basis weight/moisture gauge; air-tube threading; and automatic reel system. According to a Beloit Corp. spokesman, most tissue machines are up to 300 in. wide and operate at design speeds close to 6,000 fpm.

Tissue machines run faster than any other paper machine. Speeds of 6,800 fpm have been sustained for 24 hours. It is likely that machines will be able to run at 7,500 fpm in the 1990s, the Beloit spokesman said at an industry conference, even though the machines will probably have a 310-in.-wire width.

The 1990s will also see the following become standard: The press section will have full cantilevered frames. Extended nip presses will be used to re-

ESTIMATED ANNUAL CAPACITIES FOR TISSUE OF MAJOR PRODUCERS

(000 short tons)

	U.S.	Share of U.S. capacity (%)	Canada	Share of Canadian capacity (%)	Company total
1. James River	1,111	19.3%	—	—	1,111
2. Scott Paper	1,050	18.2	251	43.4%	1,301
3. Procter & Gamble	900	15.6	—	—	900
4. Fort Howard	800	13.9	—	—	800
5. Georgia-Pacific	537	9.3	—	—	537
6. Kimberly-Clark	430	7.5	56	9.7	486
7. Pope & Talbot	148	2.6	—	—	148
8. Chesapeake	120	2.1	—	—	120
9. Erving Paper Mills[1]	100	1.7	—	—	100
10. Orchids Paper	95	1.6			95
11. Dominion Cellulose[2]	—	—	94	16.3	94
12. Potlatch	89	1.5	—	—	89
13. Marcal Paper Mills	88	1.5	—	—	88
14. Irving Pulp[3]			75	12.9	75
15. Statler Tissue	58	1.0	—	—	58

U.S. annual capacity (1989e): 5.757 million tons
Canadian annual capacity (1989): 0.578 million short tons

1. Sale of Lockland, Ohio, mill pending.
2. Subsidiary of CIP Inc.
3. New 60,000-short-tpy machine will start up in fall 1989.

duce the water load. Through-air drying will be used for specialized grades. A self-loading pressure roll that is blind-drilled will be used to improve cross-machine moisture. The C-wrap former will become more versatile with an interchangeable plain or suction forming roll. (The crescent former is an inexpensive, high-speed alternative to the C-wrap former for machines that run at lower basis weights.) An 18-ft-dia yankee dryer over 305 in. long is probable, as are air caps between 950 and 1,000°F.

U.S. TISSUE PRICES

(BLS price index, 1987 = 100)

Year	Facial tissue	Napkins and stock	Toilet tissue and stock	Towels and stock
1989				
2Q	n.a.	108.9	116.3	117.9
1Q	110.8	107.3	110.9	116.3
1988				
4Q	105.0	103.8	106.8	113.3
3Q	104.9	103.1	105.6	110.1
2Q	103.1	102.7	103.6	105.4
1Q	100.6	100.8	100.8	100.5

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Price Indexes.

U.S. TISSUE PRICES

(BLS price index, 1982 = 100)

Year	Sanitary paper products, including stock
1989	
2Q	124.4
1Q	120.6
1988	
4Q	117.3
3Q	116.1
2Q	113.3
1Q	109.5
1987	109.1
1986	108.1
1985	106.6
1984	103.4
1983	102.1
1982	100.0
1981	98.2
1980	91.9
1979	79.1
1978	71.7
1977	66.9
1976	60.6
1975	55.0
1974	44.0
1973	35.3
1972	34.2
1971	33.8
1970	32.5

Note: Bureau of Labor Statistics' Producer Price Index was rebased to 1982 = 100 in January 1988. Index now includes sanitary products and stock.

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Price Indexes.

Paperboard:

INTRODUCTION

Paperboard is a general term describing heavyweight grades of paper used for containers, boxes, cartons, and packaging materials. Paperboard is divided into three classes: containerboard, boxboard, and other paperboard.

Containerboard is the largest single grade of paperboard produced, and it includes three major grade categories: linerboard, corrugating medium, and chip and filler boards. Most of these grades are made from virgin kraft fiber on a fourdrinier paper machine. The bulk of containerboard produced in the U.S. is consumed by domestic corrugated container plants, but a substantial proportion of linerboard—approximately 2.3 million tons in 1988—is exported.

Boxboard grades include (1) folding boxboard, (2) setup boxboard, and (3) foodboard. Folding boxboard is paperboard that is die-cut to be folded into a carton. These cartons are used to package health and beauty products, dry cereals, soap powders, electronics, toys and hardware, and other common consumer products. Folding boxboard is made from solid bleached sulfate (SBS) kraft pulp on a fourdrinier paper machine, or it is made from layers (plies) of recycled fiber on a multi-ply cylinderboard machine. Folding carton stock is usually clay coated for better printability and consumer appeal.

Setup boxes are rigid or open boxes used in specialty packaging applications. They are custom-produced and usually hand-filled with products such as shoes, jewelry, cosmetics, liquor, and candy.

Foodboard is normally produced from bleached kraft pulp on a fourdrinier paper machine. Several grades are available, each specifically coated, waxed, or otherwise treated to handle moist or oily food products. Typical grades are milk cartons, frozen food packages, ice cream cartons, cupstock, and plates.

Other paperboard includes unbleached kraft or recycled grades that are made on either cylinder or fourdrinier paper machines. These grades are used in industrial converting applications, including fiber can, core, and drum stock and liner for gypsum board. Chipboard ("cardboard") is used for pad backings or for packing flat cloths or other articles.

Total U.S. paperboard production in 1988 totaled 38.1 million short tons—almost equal to total paper production of 38.3 million tons, according to the American Paper Institute. Although paper and paperboard production are approximately equal on a tonnage basis, the dollar value of paper shipments is much greater than paperboard. In 1988, the value of paper shipments was $31.3 billion, and the value of paperboard shipments was $15.2 billion, according to data published by the U.S. Bureau of the Census.

Containerboard is the most important paperboard grade segment, with 1988 production for domestic use totaling 23.6 million tons. Boxboard output for the domestic market was 7.0 million tons, and all other types of paperboard totaled 4.4 million tons. Paperboard exports, with linerboard and solid bleached board by far the most important categories, totaled about 3.1 million tons in 1988. About 65% of U.S. paperboard tonnage is produced exclusively from solid woodpulp furnish, while 35% of paperboard contains wastepaper.

The Canadian paperboard industry is much smaller, with a total output in 1988 of roughly 2.7 million metric tons, according to the Canadian Pulp & Paper Assn. Linerboard is the most important grade, with 1988 output of 1.246 million metric tons. Corrugating medium production totaled 710,000 metric tons, and total boxboard production amounted to 724,000 metric tons.

Canadian paperboard capacity has grown little during the past decade, and the outlook is not bright because of tariff decreases scheduled under terms of the U.S.-Canada Free Trade Act. Imports from the U.S. will likely increase because of Canadian producers' higher costs.

U.S. MARKET INDICATORS FOR PAPERBOARD CONSUMPTION

Year	Paperboard consumption (million tons)	Gross national product	Personal consumption expenditures (billion 1982 constant $)		U.S. total industrial production index (1977 = 100)	Paperboard manufacturing capacity utilization
			Durable	Nondurable		
1988	34,804	4,024	$413.6	$904.5	137.2	95%
1987	34,253	3,854	388.2	878.1	129.8	96
1986	32,454	3,713	383.5	877.2	125.1	95
1985	30,373	3,607	352.7	849.5	124.2	90
1984	31,551	3,501	323.1	825.9	121.4	94
1983	29,333	3,279	283.1	880.2	109.2	91
1982	26,526	3,166	252.7	771.0	103.1	82
1981	28,741	3,249	250.8	764.9	111.0	91
1980	27,716	3,187	245.9	762.6	108.8	92
1979	29,250	3,192	266.5	766.6	110.7	94
1978	28,335	3,115	267.4	753.7	106.6	93
1977	27,150	2,959	253.9	731.4	100.0	90
1976	26,744	2,827	232.3	708.8	92.6	89
1975	23,311	2,695	205.6	676.5	84.6	79
1970	23,495	2,417	162.5	632.5	78.5	92
1965	20,301	2,088	134.6	543.2	66.1	93
1960	15,475	1,665	98.0	463.3	n.a.	82

Sources: U.S. Dept. of Commerce; American Paper Institute.

U.S. PRODUCTION OF BOXBOARD AND OTHER PAPERBOARD FOR DOMESTIC USE

(short tons)

Year	Boxboard—domestic use				Other*
	Total	Folding	Setup	Milk carton and food service	
1988	7,013,600	5,292,200	278,700	1,442,700	7,527,800
1987	6,874,100	5,209,700	242,500	1,421,900	7,520,800
1986	6,671,100	5,056,500	219,300	1,395,300	7,238,300
1985	6,412,800	4,805,100	226,600	1,381,100	6,466,800
1984	6,535,600	4,876,000	263,800	1,395,800	6,648,500
1983	6,261,100	4,646,000	256,300	1,358,800	6,742,700
1982	5,841,000	4,333,700	223,600	1,283,700	5,716,900
1981	6,216,100	4,587,600	236,000	1,392,500	5,976,100
1980	6,153,100	4,489,900	241,500	1,421,700	6,729,000
1979	6,469,200	4,720,500	306,000	1,442,700	6,135,000
1978	6,501,200	4,702,400	332,700	1,466,100	5,865,500
1977	6,332,300	4,546,700	302,500	1,483,100	5,453,500
1976	6,564,700	4,714,600	331,500	1,518,600	5,174,500
1975	5,663,800	3,896,400	304,500	1,462,900	4,505,700
1970	6,238,700	4,079,700	466,500	1,692,500	5,180,000
1965	5,811,800	3,879,600	547,300	1,384,900	4,321,200
1960	4,894,900	3,291,200	525,100	1,078,600	2,845,000

* Including linerboard exports.

Source: American Paper Institute.

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1975-88

(000 short tons)

	1988	1987	1986	1985	1984	1983	1982
TOTAL PAPERBOARD	37,730	37,187	36,002	33,291	33,515	31,871	28,912
SOLID WOODPULP FURNISH PAPERBOARD	28,463	28,083	27,897	25,293	25,619	24,169	22,145
Unbleached kraft packaging, industrial converting	18,384	18,222	17,997	16,016	16,718	15,750	14,390
Unbleached linerboard	16,988	16,919	16,740	14,897	16,648	14,689	13,297
Tube, can, and drum paperboard	68	65	54	64	74	99	151
Other, including corrugating medium	1,328	1,238	1,202	1,055	996	962	941
Bleached packaging, industrial converting (80% bleached fiber)	4,862	4,636	4,535	4,282	4,104	3,988	3,757
Linerboard	524	405	121	(D)	118	113	101
Folding carton-type board	2,063	2,023	2,706	955	1,895	1,901	1,743
Milk carton board	1,111	1,116	1,226	1,227	1,092	1,060	1,052
Heavyweight cup stock	566	486	442	422	455	440	418
Plate, dish, and tray stock	267	270	276	245	225	252	227
Bleached paperboard for miscellaneous packaging	75	55	45	29	31	31	32
Other solid bleached board	256	281	348	404	288	191	184
Semichemical, including corrugating medium, other	5,222	5,226	5,365	4,995	4,798	4,431	3,998
RECYCLED PAPERBOARD	9,162	9,001	8,004	7,901	7,797	7,604	6,607
Recycled shipping containerboard	3,186	3,131	2,495	2,561	2,407	2,565	2,097
Linerboard	976	1,029	761	918	846	879	505
Corrugating medium	2,061	1,950	1,568	1,486	1,397	1,519	1,427
Container chip and filler board	149	152	167	157	164	167	165
Recycled folding carton board	2,550	2,561	2,284	2,268	2,310	2,370	2,153
Unlined chipboard	546	537	441	468	471	585	546
Kraft-lined	137	162	219	203	169	180	146
White-lined	117	130	168	193	225	227	152
Clay-coated	1,751	1,732	1,456	1,401	1,447	1,378	1,308
Recycled setup paperboard	302	240	273	259	307	263	238
Recycled packaging, industrial converting board	3,124	3,070	2,950	2,814	2,772	2,406	2,119
Tube, can, and drum stock	1,145	1,124	1,042	1,021	1,064	858	767
Gypsum linerboard	1,239	1,227	1,145	1,029	915	798	598
Panelboard and wallboard stock	35	48	64	68	150	148	119
Other	704	671	698	646	643	602	635
WET MACHINE BOARD	101	103	101	98	99	98	172
CONSTRUCTION PAPER AND BOARD	2,583	2,615	2,967	3,228	3,010	3,215	2,781
Construction paper	356	327	302	398	394	463	447
Sheathing (red rosin, asphalt, house sheathing)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Felts, saturating and dry							
Roofing felts	256	232	210	302	(D)	(D)	(D)
Other felts, including floor covering	90	(D)	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other building (saturating screenings, etc.)	—	—	—	—	(D)	(D)	(D)
Structural insulation board	—	—	—	—	—	—	—
Insulating board	603	609	732	735	785	713	593
Hardpressed board	1,624	1,683	1,933	2,095	1,831	2,040	1,741

continued

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1975-88 (continued)

(000 short tons)

	1981	1980	1979	1978	1977	1976	1975
TOTAL PAPERBOARD	30,566	31,143	31,168	30,033	29,006	27,960	24,452
SOLID WOODPULP FURNISH PAPERBOARD	23,950	23,901	23,585	22,500	21,580	21,008	18,630
Unbleached kraft packaging, industrial converting	15,707	15,285	14,903	14,113	13,498	13,146	11,586
Unbleached linerboard	14,431	14,249	13,857	13,215	12,660	12,267	10,885
Tube, can, and drum paperboard	334	220	232	202	180	194	145
Other, including corrugating medium	942	(D)	(D)	(D)	(D)	(D)	(D)
Bleached packaging, industrial converting (80% bleached fiber)	4,070	4,034	4,065	4,002	3,883	3,846	3,421
Linerboard	120	(D)	(D)	(D)	93	103	89
Folding carton-type board	1,921	2,063	2,045	1,934	1,822	1,888	1,539
Milk carton board	1,085	1,023	1,066	1,048	1,040	1,061	1,052
Heavyweight cup stock	427	386	375	400	419	363	329
Plate, dish, and tray stock	245	273	260	227	296	267	275
Bleached paperboard for miscellaneous packaging	49	33	46	67	55	70	48
Other solid bleached board	222	78	94	117	106	77	75
Semichemical, including corrugating medium, other	4,173	4,583	4,617	4,384	4,199	4,016	3,623
RECYCLED PAPERBOARD	6,616	7,242	7,583	7,533	7,426	6,952	5,823
Recycled shipping containerboard	1,750	2,070	2,050	1,981	1,908	1,468	1,129
Linerboard	250	518	460	331	379	232	196
Corrugating medium	1,315	1,281	1,301	1,408	1,286	1,057	788
Container chip and filler board	185	271	290	242	243	179	145
Recycled folding carton board	2,425	2,350	2,386	2,403	2,423	2,475	2,108
Unlined chipboard	(D)	606	678	692	687	698	564
Kraft-lined	176	81	98	130	133	145	125
White-lined	189	220	229	251	274	325	274
Clay-coated	(D)	1,443	1,380	1,330	1,329	1,307	1,146
Recycled setup paperboard	298	560	604	697	717	748	672
Recycled packaging, industrial converting board	2,144	2,262	2,543	2,453	2,378	2,261	1,913
Tube, can, and drum stock	808	564	628	602	680	747	631
Gypsum linerboard	634	1,036	1,210	1,185	1,099	976	821
Panelboard and wallboard stock	100	113	137	119	114	86	67
Other	601	548	568	546	485	452	395
WET MACHINE BOARD	—[2]	138	144	136	129	130	115
CONSTRUCTION PAPER AND BOARD	1,460[3]	4,390	5,436	5,625	5,492	5,419	4,648
Construction paper	616	1,369	1,868	1,915	1,852	1,832	1,616
Sheathing (red rosin, asphalt, house sheathing)	(D)	3	14	13	21	22	16
Felts, saturating and dry							
Roofing felts	510	1,205	1,633	1,672	1,601	1,553	1,402
Other felts, including floor covering	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	(D)	62	100	113	106	114	91
Other building (saturating screenings, etc.)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Structural insulation board	—	3,021	3,569	3,710	3,640	3,586	3,032
Insulating board	845	1,051	1,263	1,416	1,403	1,441	1,249
Hardpressed board	(S)	1,970	2,306	2,294	2,237	2,145	1,784

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.
(D) = Data withheld to avoid disclosing figures for individual companies.
(S) = Suppressed because the data did not meet publication standards by Bureau of the Census.

[1] Reported as production by Bureau of the Census prior to 1981.

[2] Wet machine board included with recycled paperboard to avoid disclosing figure for individual companies.

[3] Excludes hardboard.

Source: Bureau of the Census.

U.S. PRODUCTION OF CONTAINERBOARD FOR DOMESTIC USE

(000 short tons)

Year	Total	Linerboard Kraft	Linerboard Recycled	Linerboard Total	Corrugating materials Semichemical and kraft	Corrugating materials Recycled	Corrugating materials Total	Chip and filler boards
1988	23,563.2	15,770.7	406.6	16,177.3	5,527.7	1,823.2	7,350.9	35.0
1987	23,047.1	15,514.4	478.3	15,992.7	5,343.8	1,673.1	7,016.9	37.5
1986	21,446.0	14,305.5	420.3	14,725.8	5,163.5	1,525.8	6,689.3	30.9
1985	20,042.2	13,467.1	285.8	13,752.9	4,896.6	1,358.8	6,255.4	33.9*
1984	20,855.1	14,068.8	203.7	14,272.5	5,018.9	1,385.4	6,404.3	178.4
1983	19,173.0	12,835.6	289.1	13,124.7	4,532.7	1,305.4	5,838.1	210.2
1982	17,507.5	11,656.5	279.0	11,935.5	4,202.5	1,139.3	5,341.8	230.2
1981	19,040.4	12,754.3	324.2	13,078.5	4,561.2	1,140.9	5,702.1	259.5
1980	18,070.2	11,948.6	444.5	12,393.1	4,398.5	1,047.1	5,445.6	231.5
1979	18,824.8	12,417.3	402.3	12,819.6	4,573.6	1,202.3	5,775.9	229.3
1978	17,908.2	11,877.2	256.4	12,133.7	4,305.3	1,197.7	5,503.1	271.5
1977	17,167.3	11,354.4	341.3	11,695.7	4,128.2	1,079.7	5,207.9	263.7
1976	16,700.2	11,093.2	282.7	11,375.9	3,986.5	1,075.1	5,061.5	262.9
1975	14,586.2	9,646.9	207.3	9,854.2	3,579.4	870.0	4,449.3	282.6
1970	13,964.3	9,133.4	269.7	9,403.1	3,404.7	859.3	4,264.0	297.2
1965	11,199.1	6,698.1	782.5	7,480.6	2,638.2	800.0	3,438.2	280.3
1960	8,186.6	4,731.2	743.6	5,474.8	1,788.9	672.1	2,461.0	250.8

* Reclassification. Balance of chipboard (non-container grades) not included.

Source: American Paper Institute

U.S. PRODUCTION AND CAPACITY OF PAPERBOARD

(000 short tons)

Year	Production[1] (000 tons)	Production[1] Change (%)	Capacity[1] (000 tons)	Capacity[1] Change (%)	Utilization rate(%)
1991e	—	—	43,933	3.8%	—
1990e	—	—	42,321	2.9	—
1989e	—	—	41,128	2.5	—
1988	38,105	1.8%	40,116	2.6	95.0%
1987	37,442	5.9	39,106	3.5	95.7
1986	35,355	7.4	37,763	2.8	94.6
1985	32,922	-3.3	36,720	2.0	90.0
1984	34,039	6.5	35,992	1.1	95.6
1983	31,951	9.9	35,603	0.5	89.7
1982	29,065	-6.9	35,421	2.8	82.1
1981	31,232	0.9	34,466	1.6	91.2
1980	30,952	-1.9	33,709	0.8	91.8
1979	31,429	3.8	33,436	2.5	94.0
1978	30,275	4.6	32,631	1.4	92.8
1977	28,953	1.8	32,173	0.2	90.0
1976	28,439	14.8	32,097	2.8	86.0
1975	24,756	—	31,218	—	79.3
Average 1970-88		2.8		2.0	

e = Estimate.

[1] Excludes capacity for hardpressed board, wet machine board, and construction paper and board.

Source: American Paper Institute (1988 capacity survey).

CANADIAN PAPERBOARD CAPACITY

(000 short tons)

Year	Linerboard Kraft	Linerboard Recycled	Corrugating medium Semichemical	Corrugating medium Recycled	Solid bleached board	Boxboard Folding, others[1]
1990	1,076	416	680	152	69	838
1989	1,076	416	679	152	69	814
1988	1,076	402	623	152	69	785
1987	1,036	361	609	157	68	782
1986	1,022	325	586	161	80	774
1985	1,001	321	565	172	92	787
1984	983	314	576	164	95	785
1983	952	315	581	129	98	747
1982	969	300	564	150	104	732
1981	1,069	322	557	129	102	770
1980	1,056	289	545	114	105	785
1979	1,074	267	520	115	137	832
1978	1,069	272	517	116	135	812
1977	1,300	278	510	116	131	757

1. Includes mill wrappers but excludes solid bleached board.

Source: Canadian Pulp & Paper Assn.

CANADIAN EXPORTS OF PAPERBOARD[1]

(000 short tons)

Year	Linerboard	Corrugating medium	Boxboard
1988	348	246	75
1987	358	241	88
1986	352	220	73
1985	321	151	69
1984	271	218	95
1983	310	197	63
1982	213	158	31
1981	295	170	37
1980	361	201	40
1979	288	157	39
1978	283	177	54
1977	393	105	20
1976	318	90	7
1975	198	53	11
1974	414	96	22
1973	311	140	23
1972	222	147	17
1971	173	133	22
1970	201	102	13
1965	123	46	16

1. Canadian imports of paperboard are minor. For example, in 1986, Canada imported 43,000 tons of containerboard.

Source: Canadian Pulp & Paper Assn.

CANADIAN PAPERBOARD PRODUCTION

(000 short tons)

Year	Containerboard		Boxboard				Total paperboard
	Linerboard	Corrugating medium	Folding	Non-folding	Bleached board	Other[1]	
1988	1,371	781	358	62	64	238	2,970
1987	1,383	769	n.a.	n.a.	n.a.	n.a.	2,966
1986	1,322	714	391	114	—[2]	353	2,836
1985	1,187	549	385	111	—[2]	332	2,564
1984	1,128	626	363	142	—[2]	329	2,588
1983	1,026	589	355	128	—[2]	295	2,391
1982	967	466	305	115	—[2]	270	2,123
1981	1,182	571	331	130	—[2]	328	2,541
1980	1,224	527	310	118	—[2]	322	2,499
1979	1,145	483	315	119	—[2]	373	2,434
1978	1,146	459	272	133	—[2]	354	2,364
1977	1,011	376	238	133	—[2]	209	2,066
1976	1,025	373	224	80	—[2]	272	1,974
1975	784	343	192	101	—[2]	238	1,658
1970	776	373	250	111	107	233	1,850
1965	595	251	265	104	89	250	1,553
1960	375	208	233	65	14	172	1,067
1955	259	158	186	48	—	219	869
1950	214	152	158	48	4	204	708

n.a. = Not available.

[1] Includes solid bleached board, mill wrappers, gypsum or plaster board, wet machine board, etc., from 1975 on.

[2] Included in "Boxboard, Other."

Source: Canadian Pulp & Paper Assn.

Paperboard:

LINERBOARD

Linerboard is a commodity grade of paperboard used in the production of corrugated containers. It is used as the inner and outer facing (liner) in combination with corrugating medium (the fluted inner sheet) to form the rigid structure of the combined board. Linerboard provides the strength component of a container, while corrugating medium gives rigidity or stiffness. Linerboard is sold in rolls; the width of the roll is determined by corrugator width.

Unbleached linerboard is made in a wide range of basis weights. The standard kraft liner is 42 lb/1,000 ft^2, but other important grades are produced in weights of 26, 33, 38, 69, and 90 lb. About 92% of linerboard is unbleached, and the remainder is either solid bleached or recycled. Kraft linerboard is produced at large, integrated kraft pulp and paper mills. About 83% of U.S. linerboard capacity is located in the South, and most of the rest is in the West. Some linerboard is also produced in eastern Canada and British Columbia. (See Corrugating Medium chapter for discussion of the Canadian industry.)

Most linerboard is produced on wide (220-in.- to 348-in.-trim) conventional fourdrinier paper machines at speeds approaching 2,000 fpm or more. About 60% of industry capacity is now represented by machines with capacity to produce 300,000 to 500,000 tpy. Approximately 90% of the linerboard paper machines in the industry have been installed or substantially rebuilt in the last two decades.

Normally, the wet end of the fourdrinier machine used to manufacture linerboard has two forming devices or headboxes that form two different plies or layers of fiber. The primary layer, comprising up to 85% of the fiber furnish, contains coarse, strong, high-yield kraft fiber, which means that a minimum amount of the natural binding chemicals contained in the wood are removed during the pulping process. The top layer contains higher-quality pulp (either of lower fiber yield or highly refined) with better sheet properties that permit a good printing surface. In some grades, the top layer may be bleached fiber that is used to produce a mottled white appearance over an unbleached basesheet.

Special chemical additives are either mixed into the pulp slurry or extruded onto the surface of the formed sheet to give linerboard its unique properties. The most common internal additives are sizes and wet-strength agents used to develop desired sheet strength and moisture resistance. About 4% of linerboard produced in the U.S. is wet-strength treated. The most common surface additive is starch, which is applied at a size press on the paper machine in order to seal the surface of the sheet for increased strength and printing smoothness.

Compression strength. Basis weight and bursting strength have historically been the two main quality specifi-

U.S. STATISTICS FOR UNBLEACHED KRAFT LINERBOARD

	1989e	1988	1987
Production, 000 tons	18,254	17,897	17,683
Capacity[1], 000 tons	19,334[2]	18,613	17,949
Utilization rates[1], %	94.4	96.2	98.5
Exports[3], 000 tons	2,400	2,281	2,297
Imports[3], 000 tons	78	83	81
Apparent U.S. consumption			
000 tons	15,932	15,699	15,467
lb/capita	128.3	128.0	127.3
000 tons/$ billion real GNP	4.00	4.02	4.05

e = Estimate.
1. American Paper Institute, *Pulp & Paper* estimates.
2. Revised upward by 250,000 tpy to reflect shift of capacity from kraft paper production. Adjustment also reflects capacity expansion beyond what was reported in the 1988 API survey.
3. Dept. of Commerce data.

cations for linerboard under freight-carrier classifications (railroad Rule 41 and trucking Item 222) that regulate corrugated shipping containers. Bursting strength is simply a measure of how well a corrugated container will protect its contents during individual loading into railroad cars. Recently, many mills have begun producing linerboard and corrugating medium that also meet certain minimum ring-crush standards. Ring crush relates to the top-to-bottom compression strength of the finished corrugated box, which is a critical measure of stacking height.

Increased transport and stacking of boxes on pallets has made compression strength an important measure of box performance. (See Converted Products chapter.) The movement toward performance-based packaging emphasizes the strength-to-weight ratio of corrugated packaging. Many companies have developed high-strength linerboard that allows box makers to use lighter-weight yet stronger packaging while reducing costs. This also reduces mill costs because less fiber is required to impart strength, and the linerboard produced typically has a lower basis weight, thus reducing fiber use overall.

Among the largest producers of such high-performance containerboard are Union Camp Corp., Great Northern Nekoosa Corp., Stone Container Corp., and International Paper Co. Although the industry has no standard definition for such grades, some industry managers define high-performance containerboard as those grades of linerboard offering at least two pounds of ring-crush strength for each pound of basis weight.

Secondary fiber use. Unbleached kraft linerboard is made mainly from softwood trees (southern pine, Douglas fir, and eastern pines and spruces), but some mills have also traditionally used some hardwood species in the pulp furnish. In the past few years, the use of wastepaper fiber in kraft linerboard manufacture has also grown, increasing from 4% of total fiber furnish in the late 1970s to around 13% currently. The principal wastepaper grades used are old corrugated containers (occ) and new double-lined kraft cuttings. Usage varies, but the maximum amount of wastepaper consumed by any kraft linerboard mill is generally not over 25% of total fiber furnish.

A few U.S. mills produce linerboard from 100% wastepaper on either fourdrinier or multi-ply cylinder machines. This grade is called "test" linerboard, and it is typically produced in heavier basis weights. Currently, recycled linerboard supplies about 3% of total domestic linerboard demand. Testliner traditionally fills the gap when kraft linerboard is in short supply, a situation that occurred in both 1980 and 1987 when production jumped to nearly 500,000 tons. In both cases, production declined the following year as the kraft linerboard supply/demand equilibrium was reestablished.

U.S. PRODUCTION AND CAPACITY OF UNBLEACHED LINERBOARD

(000 short tons)

	Production		Capacity		Operating
Year	Tonnage	Change (%)	Tonnage	Change (%)	rate (%)
1990e	—	—	19,796	2.4%	—
1989e	18,254	2.0%	19,334	3.9	94.4%
1988	17,897	1.2	18,613	3.7	96.2
1987	17,683	7.8	17,949	4.5	98.5
1986	16,402	8.0	17,175	2.6	95.4
1985	15,183	-5.3	16,739	1.1	90.7
1984	16,037	6.9	16,565	1.8	96.8
1983	15,007	11.2	16,217	1.5	92.5
1982	13,494	-7.2	16,032	4.3	84.2
1981	14,540	2.2	15,372	5.2	94.6
1980	14,232	2.0	14,586	2.7	97.6
1979	13,951	5.5	14,199	2.4	98.3
1978	13,228	5.2	13,864	1.9	95.4
1977	12,573	2.6	13,586	1.4	92.5
1976	12,251	12.4	13,448	2.4	91.1
1975	10,635	-10.6	13,138	1.8	80.9
1974	12,333	-3.7	12,901	0.3	95.6
1973	12,536	4.4	12,862	2.3	97.5
1972	12,335	9.1	12,568	6.5	98.1
1971	11,308	3.0	11,797	0.6	95.9
1970	10,982	0.3	11,718	—	93.7

e = Estimate.

Sources: American Paper Institute, *Pulp & Paper* estimates.

The main motivation for building recycled linerboard capacity is the low capital cost of new mill construction—equivalent to approximately $250,000/daily ton of capacity vs about $400,000/daily ton of capacity for construction of a new greenfield kraft linerboard mill. In addition, government regulations and tax incentives are being used to promote wastepaper recycling. This is especially true on the West Coast and in the large metropolitan areas of the Midwest and Northeast where occ supplies are plentiful and shipping costs are favorable.

Inland Container Corp. constructed a new 175,000-tpy recycled linerboard mill in Ontario, Calif., in 1985—the first such facility to be built in the U.S. using modern recycling technology. Kenaf of North America Inc. has announced plans to build a $130-million, 265,000-tpy recycled linerboard mill in Muskogee, Okla., for completion in late 1991. Daishowa America Co. Ltd., the U.S. affiliate of Japan's

Daishowa Paper Mfg. Co. Ltd., plans to construct and operate a 350,000-tpy containerboard mill in Stockton, Calif., using 100% wastepaper. However, several recycled linerboard projects announced for the Northeast have moved ahead slowly.

Gaylord Container Corp. is converting the former Crown Zellerbach recycled containerboard mill in Antioch, Calif., to production of a blended linerboard sheet containing mainly kraft pulp (piped in from the former Louisiana-Pacific Corp. mill that the company acquired next door).

MONTHLY CONTAINERBOARD INVENTORY AT U.S. BOX PLANTS AND MILLS

(000 short tons/weeks of supply*)

	1989**		1988		1987		1986		1985	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan. 1	2,546	5.4	2,486	5.7	2,238	6.0	2,549	7.1	2,882	8.4
Feb. 1	2,702	5.6	2,663	5.7	2,340	5.6	2,502	5.7	2,970	7.4
Mar. 1	2,606	5.8	2,584	5.8	2,391	5.4	2,489	6.1	2,955	7.7
Apr. 1	2,564	5.7	2,513	5.7	2,414	5.6	2,518	6.2	3,023	8.0
May 1	2,558	5.1	2,552	5.1	2,375	5.2	2,438	5.5	2,987	7.3
June 1	2,491	5.5	2,595	5.9	2,383	5.6	2,394	6.1	2,945	7.6
July 1	2,471	5.5	2,617	6.0	2,385	5.4	2,320	5.5	2,838	7.5
Aug. 1	2,687	5.5	2,723	5.9	2,497	5.6	2,389	5.7	2,821	7.3
Sept. 1	2,660	5.9	2,731	6.2	2,437	5.5	2,344	5.8	2,694	7.0
Oct. 1	2,632	5.5	2,672	5.8	2,421	5.2	2,269	5.2	2,560	6.1
Nov. 1	—	—	2,519	5.0	2,352	5.0	2,181	4.8	2,492	5.8
Dec. 1	—	—	2,487	5.3	2,396	5.7	2,134	5.3	2,469	6.6

	1984		1983		1982		1981		1980	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan. 1	2,437	7.2	2,584	8.9	2,729	9.4	1,984	6.2	1,979	6.2
Feb. 1	2,408	6.0	2,485	7.1	2,482	7.5	1,960	5.5	1,991	5.3
Mar. 1	2,467	6.4	2,462	7.2	2,468	7.3	2,029	5.6	1,905	5.4
Apr. 1	2,448	6.4	2,414	6.8	2,570	7.4	2,104	5.7	1,890	5.4
May 1	2,512	6.2	2,495	6.9	2,656	7.6	2,232	5.9	2,021	5.7
June 1	2,541	6.5	2,463	6.8	2,671	8.1	2,298	6.7	2,119	6.5
July 1	2,659	7.1	2,511	6.8	2,650	7.9	2,368	6.7	2,248	7.0
Aug. 1	2,767	7.2	2,486	7.4	2,595	8.3	2,371	6.9	2,291	7.3
Sept. 1	2,711	7.0	2,421	6.6	2,553	7.5	2,376	6.9	2,225	7.1
Oct. 1	2,702	6.9	2,339	6.0	2,393	6.5	2,451	6.6	2,101	5.8
Nov. 1	2,602	6.2	2,302	5.8	2,424	6.9	2,437	7.1	1,880	5.6
Dec. 1	2,650	7.1	2,415	6.5	2,524	7.6	2,602	7.9	1,836	5.5

	1979		1978		1977		1976		1975	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan. 1	1,961	5.8	2,437	7.2	2,507	8.0	2,185	7.2	2,323	4.7
Feb. 1	1,825	5.1	2,297	7.0	2,376	7.8	2,136	7.0	2,156	4.6
Mar. 1	1,807	5.1	2,242	6.6	2,393	7.7	2,138	7.1	2,233	4.6
Apr. 1	1,789	5.0	2,208	6.1	2,412	7.5	2,172	7.0	2,264	4.7
May 1	1,846	4.8	2,179	6.4	2,463	7.4	2,316	7.4	2,306	5.0
June 1	1,856	5.2	2,155	6.0	2,513	7.5	2,393	7.5	2,296	5.4
July 1	1,863	5.3	2,169	6.1	2,577	8.0	2,506	8.2	2,244	5.8
Aug. 1	1,939	5.5	2,206	6.6	2,581	8.3	2,539	8.4	2,125	5.9
Sept. 1	1,945	5.6	2,119	6.0	2,613	8.0	2,604	8.5	2,079	6.3
Oct. 1	1,938	5.3	2,004	5.5	2,457	7.2	2,442	7.7	1,969	6.4
Nov. 1	1,877	4.8	1,923	5.1	2,439	7.1	2,456	7.6	1,964	6.7
Dec. 1	1,953	5.5	1,939	5.6	2,442	7.2	2,516	7.9	2,079	7.0

* = Obtained by dividing inventories by average weekly usage in corrugated box plants during prior month, excluding holidays.
** = Preliminary.

Source: Fibre Box Assn.

RATIO OF U.S. CONSUMPTION OF PAPERBOARD TO CORRUGATED CONTAINER PRODUCTION

CORRUGATING MEDIUM TONNAGE FOR CONTAINERS

Year	Consumption by box plants (000 short tons) Liner-board	Corrugating medium	Ratio (liner/ medium)
1988	15,751	7,317	2.15
1987	15,276	7,086	2.16
1986	14,414	6,689	2.15
1985	13,605	6,247	2.17
1984	13,461	6,177	2.18
1983	12,594	5,768	2.18
1982	11,751	5,337	2.20
1981	12,262	5,530	2.22
1980	12,019	5,427	2.21
1979	12,456	5,654	2.20
1978	12,168	5,495	2.21
1977	11,318	5,103	2.22
1976	10,782	4,844	2.22
1975	9,609	4,320	2.22
1974	10,621	4,746	2.24
1973	11,315	5,060	2.24
1972	10,429	4,698	2.22
1971	9,465	4,273	2.22
1970	9,079	4,107	2.21

LINERBOARD TONNAGE FOR CONTAINERS

Year	Corrugator production (billion ft^2)	Linerboard consumed by box plants (000 tons)	Ratio (1,000 ft^2/ ton)
1988	329.4	15,751	20.913
1987	318.5	15,276	20.850
1986	302.0	14,414	20.950
1985	284.8	13,605	20.933
1984	282.0	13,461	20.949
1983	264.2	12,594	20.980
1982	246.3	11,751	20.960
1981	253.0	12,262	20.633
1980	251.9	12,019	20.958
1979	261.1	12,456	20.962
1978	256.4	12,168	21.072
1977	238.8	11,318	21.099
1976	227.8	10,782	21.128
1975	203.2	9,609	21.147
1974	224.1	10,621	21.100
1973	238.5	11,315	21.078
1972	220.1	10,429	21.105
1971	200.3	9,465	21.162
1970	192.7	9,079	21.225
		Average:	21.016

Source: Based on data from Fibre Box Assn.

Macon Kraft Co. is also producing a blended sheet on one machine at its Macon, Ga., mill. The most growth in wastepaper consumption will probably come from supplemental use of wastepaper at existing kraft linerboard mills. New multi-ply forming and high-pressure press technology permit more use of wastepaper and hardwood fiber without loss of quality.

Graphic display. Most U.S. linerboard is unbleached, but grades with a solid white or mottled white printing surface are growing in importance. Currently, they account for about 8% of total production. This reflects growing use of corrugated containers for point-of-purchase display in retail outlets. The most common grade for this application is mottled white linerboard, in which a thin layer of bleached fiber is added to the top of an unbleached sheet. Production of mottled white board in 1988 totaled more than 1.0 million tons, and it has grown at a 7.7%/year rate since 1980. The largest producers are believed to be Container Corp. of America and St. Joe Paper Co., followed by Green Bay Packaging Inc. and Chesapeake Corp.

A higher-quality, more expensive alternative is solid bleached linerboard. Production of this grade in 1988 totaled 170,000 tons, and it has grown at a 9.5%/year rate since 1980. Temple-Inland Inc. is believed to be the largest supplier of solid bleached linerboard.

A third alternative is the use of clay-coated unbleached kraft board in the preprint process. (See Coated and Uncoated Kraft Board chapter and Converted Paper and Board Products chapter.) Use of such coated board is believed small because preprint has been slow to develop high-volume applications and because supply is limited. More clay-coated board for linerboard applications will become available when Mead Corp. starts up its 420,000-tpy clay-coated kraft board machine in 1991.

In late 1989, Chesapeake plans to introduce in the U.S. a white-top linerboard grade that it hopes will open the high-volume end of the high-quality graphics market for preprint. Several other companies are also planning to introduce a white-top grade in the U.S. in 1989 or 1990. Production of such white-top and coated kraft grades is expected to grow rapidly in the U.S. over the next five years. (Detailed information on these changing quality trends is available in *Growing Linerboard Specialties: White Grades and High-Performance Grades*, written by Coleman Rowland and published by *Pulp & Paper* Forecasting Services.)

Multi-ply forming. The need for linerboard with higher cross-machine strength (measured by ring crush) and with better printing surfaces led to growing interest in multi-ply linerboard forming. Beyond the traditional fourdrinier and secondary headbox, some U.S. companies are adding top-wire dewatering units or mini-fourdriniers to produce two- or three-ply sheets. Willamette Industries Inc. recently added Bel Bond formers to all of its linerboard machines, and several other companies are planning similar installations. Georgia-Pacific Corp. recently rebuilt its No. 2 machine with an Escher Wyss top-former fourdrinier to produce a two-ply board. In 1985, Chesapeake's West Point, Va., mill started up a new Voith machine with four forming sections to produce a three-ply sheet.

These machines can use different fiber furnishes and also produce partially bleached grades such as white-top or mottled board. Low cross-machine variation in basis weight and moisture profile is important for high-speed converting.

High-pressure presses. Companies are installing high-impulse or wide-nip presses to add incremental capacity and to improve sheet strength. High-impulse presses make use of higher-than-usual linear press loadings—typically 1,000 to 2,000 psi or greater—as well as double felting and a nip width of 3.0 to 3.5 in. Wide-nip presses (such as Beloit Corp.'s Extended Nip Press) usually increase nip pressure in the press section by passing a sheet between a single-grooved press roll opposed by a stationary loaded shoe. Pressure equivalent to 4,500 to 6,000 pli can be achieved because of the longer dwelltime of the sheet in the double-felted press (with nips ranging up to 10 in.).

The increased pressure can reduce steam requirements per ton in the dryer section by as much as 15% to 25%. It can also boost incremental capacity by 8% to 12% or more. Dryness of the sheet leaving the press can be raised to over 50%, and some mills are installing tandem high-intensity or wide-nip press sections to achieve after-press dryness levels approaching 60%. Wide-nip presses also increase sheet strength, or permit mills to use more secondary or hardwood fiber while maintaining the same strength level.

Weyerhaeuser Paper Co. mills in Springfield, Ore., and Plymouth, N.C., pioneered the installation of Beloit's Extended Nip Press on linerboard machines in the early 1980s. Several other companies have since installed high-impulse or wide-nip presses, and other suppliers besides Beloit have developed presses that achieve similar results. In a project completed in mid-1989, International Paper became the first U.S. producer to install a double wide-nip press (Voith Flex-o-Nip) at its Vicksburg, Miss., mill. Gaylord Container's new machine at Bogalusa, La., will have multi-ply forming and two Extended Nip Presses.

FACTORS FOR CONVERTING PRICES FROM $/TON TO $/1,000 FT^2, AND FROM $/1,000 FT^2 TO $/TON

Basis weight (lb/1,000 ft^2)	FACTOR 1 $/1,000 ft^2 to $/ton	FACTOR 2 $/ton to $/1,000 ft^2
26*	76.92	0.01300
31*	64.52	0.01550
33*	60.61	0.01650
36*	55.56	0.01800
38	52.63	0.01900
42	47.62	0.02100
47	42.55	0.02350
69	28.98	0.03451
90	22.22	0.04500

To convert the price per 1,000 ft^2 to equivalent price on a per-ton basis, multiply the price by FACTOR 1. For example, if the price of 33-lb linerboard is $4.79/1,000 ft^2, multiply $4.79 by 60.61. The price per ton is $290.

To convert the price per ton to equivalent price per 1,000 ft^2, multiply price by FACTOR 2.

* Corrugating medium weights. Linerboard is normally produced at 26, 33, 38, 42, 47, 69, and 90 lb/1,000 ft^2.

MARKET STRUCTURE

The U.S. linerboard industry in 1988 produced 17.9 million tons of kraft linerboard, of which about 2.3 million tons were exported. (As previously noted, the industry also produced 407,000 tons of recycled linerboard and 169,800 tons of solid bleached linerboard.)

The U.S. linerboard industry has a fairly high degree of integration, with about 73% of production transferred by companies to their own box plants or swapped with other producers to save on freight costs. About 15% of production is sold by producers to independent corrugated converters, and the remaining 13% to 14% is exported overseas. A small amount of linerboard also finds its way into miscellaneous uses such as tube, can, and core stock.

The two main determinants of linerboard demand are domestic corrugated box production and linerboard export shipments. In turn, corrugated box shipments closely track U.S. industrial production, and over the past decade they grew at a 3.1%/year rate. Linerboard production during the 1978-87 period grew at a 3.6%/year rate, reflecting somewhat stronger growth in export shipments. U.S. linerboard exports grew at a 7.3%/year rate during the past decade, helped by strong demand from Far East markets.

Linerboard prices tend to be highly cyclical, usually rising during the middle and later stages of an economic recovery, but falling when demand weakens and producers scrape for business to keep their capital-intensive mills running. Pricing tends to be strongest when operating rates are around 95% or higher and when inventories are below six weeks of supply. Normally, linerboard and corrugating medium prices tend to push up corrugated container prices.

CURRENT LINERBOARD GRADE STRUCTURE*

Basis weight (lb/1,000 ft^2)	Grade distribution (%)
26	4%
33	12
38	4
42	50
47	1
69	22
90	3
other	4

* = For domestic use.

Source: Fibre Box Assn., 1988.

Containerboard raw materials account for about 50% to 55% of the cost of making a corrugated container.

In market downturns, prices sometimes drop nearly to variable manufacturing costs (including delivery). The largest cost factor in producing linerboard is wood, which accounts for about 36% of total manufacturing costs (including interest and depreciation). Labor accounts for 13% of total costs, followed by energy (8% to 9%) and chemicals (5%). Domestic delivery costs average about $30 to $35/ton, while delivery costs are about $40 to $50/ton to Europe and about $55 to $70/ton to the Far East.

CURRENT MARKET CONDITIONS

The linerboard industry went into a sharp slump in 1985 due to the strong U.S. dollar, which depressed U.S. linerboard export shipments. Linerboard exports dropped from 2.3 million tons in 1983 to a low of 1.8 million tons in 1985. Domestic demand was not strong enough to absorb the excess tonnage, and containerboard inventories at box plants and mills began to mount, hitting a record 3.0 million tons (8.0 weeks of supply) in the spring of 1985.

CAPACITY RANKING OF U.S. KRAFT LINERBOARD PRODUCERS

	Company	Annual capacity (000 short tons)	Capacity share (%)
1	Stone Container	2,750[1]	14.4%
2	International Paper	1,850	9.7
3	Weyerhaeuser	1,530	8.0
4	Jefferson Smurfit/CCA	1,450	7.6
5	Georgia-Pacific	1,375	7.2
6	Union Camp	1,350	7.1
7	Great Northern Nekoosa	1,250	6.5
8	Temple-Inland	1,235[2]	6.5
9	Packaging Corp. of America	800	4.2
10	Willamette Industries	800	4.2
11	Gaylord Container	725	3.8
12	Westvaco	610	3.2
13	Longview Fibre	600	3.0
14	Macon Kraft	550	2.8
15	St. Joe Paper	480	2.5
16	MacMillan Bloedel	420	2.2
17	Boise Cascade	410	2.2
18	Green Bay Packaging (Arkansas Kraft)	378	2.0
19	Chesapeake	350	1.8
20	Champion International	330	1.7
21	Interstate Resources	280	1.4
22	Simpson Paper (Simpson Tacoma Kraft)	220	1.1

Total U.S. capacity (1989): 19.084 million tons
Capacity share of top 5 companies: 46.9%
Capacity share of top 10 companies: 75.4%

1. Includes all of Stone Container's 49%-owned Seminole Kraft Corp. mill in Jacksonville, Fla., reactivated in 1987 (total liner capacity 350,000 tpy). Excludes Canadian (216,000 tpy) and European mills from 1989 Consolidated-Bathurst acquisition.
2. Excludes 205,000-tpy recycled liner mill in Ontario, Calif.

Source: *Pulp & Paper* estimates.

The price of linerboard dropped from a peak of $340/ton in the fall of 1984 to a low of about $250 to $260/ton in the second half of 1985. Average mill net prices were even lower because of $10 and $20/ton zone rebates based on shipping distance from mills and because of abysmal export prices. Such price levels were far below the estimated $270 to $290/ton break-even level for an average southern mill (including depreciation and freight). What helped limit the gush of red ink for many integrated producers was the fact that corrugated box prices eroded more slowly than linerboard prices. While linerboard prices declined by about 25% during this period, corrugated box prices eroded only about 12%.

Producers took heavy downtime in 1985 to bring supply into better balance with demand. Operating rates for the year averaged under 91%—down from 97% the preceding year. Demand began to improve in 1986, helped by the weakened dollar, which revived U.S. corrugated box shipments (up 6.2% for the year) and linerboard exports. Linerboard production in 1986 rose 8%, and export shipments surged 20% to nearly 2.2 million tons. Inventories of containerboard dropped back to 2.2 million tons (4.8 weeks of supply) by the end of 1986. Producers pushed through a $30/ton price increase to $290/ton in April, and they implemented another increase to $320/ton in the fall.

The market continued to tighten during the next year, with linerboard mill operating rates rising from 95% in 1986 to 99% in 1987. Prices rose $30/ton to $350/ton in January, followed by another increase to a new peak of $380/ton in August 1987. U.S. export shipments rose 5.4% to 2.3 million tons, and they were probably held back by linerboard availability. The strong market conditions continued in 1988, with linerboard mills still running at full capacity. Producers implemented another $30/ton price increase to $410/ton in March 1988, which resulted in an unprecedented level of industry profitability.

The average southern mill had an estimated pretax profit of nearly $110/ton in 1988 (including depreciation and interest). This followed an essentially break-even performance by the industry during the first half of the decade, with losses in 1982-83 and 1985.

Fairly robust industry conditions prevailed in 1989, but producers were unable to push through another $30/ton price increase to $440/ton in the spring because of strong resistance from independent converters, slower growth in corrugated box shipments, sluggish linerboard export demand, and increasing supply from a large number of incremental expansion projects underway. As a result, mill operating margins have probably begun to erode because of slippage in export prices and gradual inflation in manufacturing costs. The squeeze has been most intense for linerboard mills on the West Coast, where woodchip costs more than doubled in 1989.

Corrugated box shipments slowed to about 2% annual growth in 1989, compared with growth rates of 3.6% in 1988 and 4.9% in 1987. However, the U.S. linerboard industry should have a fairly good year, with production up around 1.5% and with mills operating at about 95% capacity. Unfortunately, margin relief through another price increase may be difficult to achieve due to strong industry capacity growth during the 1988-91 period (3.7%/year) combined with the possibility of an economic slowdown.

U.S. linerboard capacity expansion is gaining momentum as high operating rates and rising prices improve potential return on investment. The American Paper Institute's 1988 survey shows linerboard capacity rising at a 3.9%/year rate during the 1989-91 period—up from a 2.8%/year rate during the 1985-87 period. In 1988 alone, the capacity base jumped 3.7% to 18.6 million tons. Most of the increase is from incremental expansion activity, particularly the installation of high-pressure presses, and from the shift of kraft paper capacity to linerboard production.

The spread of new high-pressure presses may be responsible for a faster-than-normal upward "creep" in the U.S. industry's capacity base. For example, API's 1984 capacity survey projected total unbleached kraft paperboard capacity would reach 18.384 million tons by the end of 1987. The 1987 API survey estimated the figure at 19.421 million tons. Historically, industry capacity has risen about 300,000 to 400,000 tons during the four-year span from when capacity is first estimated to when it becomes the base year of a new forecast. During the 1983-87 span, capacity creep turned into a surge, jumping 1.04 million tons.

Only two new kraft linerboard machines have been announced. Union Camp announced a 460,000-tpy lightweight linerboard machine as part of a $375-million modernization at its Savannah, Ga., mill. (Net capacity increase would be about 150,000 tpy, however, because of the mothballing of two older machines.) Gaylord Container plans to install a 350,000-tpy linerboard machine at its Bogalusa, La., mill in 1990. In addition, Mead is installing a new 350,000-tpy coated kraft board machine for 1990 startup at its Mahrt, Ala., mill. Mead's new machine may produce 40% to 50% unbleached linerboard in its early years if coated kraft sales fall below the machine's rated capacity. As noted earlier, at least two new recycled linerboard machines also have been announced.

The era of constructing huge linerboard mills in the U.S. has passed because current linerboard prices are still below the level needed to justify the heavy investment required. In a 1989 speech, Roger W. Stone, chairman of Stone Container, estimated that it would cost $700 million to replace his company's 1,850-tpd linerboard mill in Florence, S.C. He said linerboard prices would have to be near $500/ton for the company to achieve a reasonable return on such an investment. The cost of the Florence mill converts to about $380,000/daily ton vs about $250,000/daily ton for a recycled mill. Because of these economic considerations, several companies are studying the construction of new recycled linerboard mills or the upgrading of older kraft mills.

Incremental expansion in vogue. A popular incremental expansion strategy is the installation of high-impulse or wide-nip presses accompanied by a wastepaper recycling line or debottlenecking of the kraft recovery system. High-pressure presses can add as much as 8% to 12%

U.S. LINERBOARD INDUSTRY CONSOLIDATION

Year	Acquiring company	Selling entity	Capacity of assets (000 tons) Un-bleached[1]	Capacity of assets (000 tons) Total capacity	Price (million $)
1988	Gaylord Container	Louisiana-Pacific (Antioch mill)	247	247	$156
1987	Great Northern Nekoosa	Owens-Illinois (Forest Products Div.)	1,040	1,040	1,170
1987	Pratt Holdings	Georgia Kraft (Macon mill)	525	525	272[2]
1987	Stone Container	Southwest Forest Industries	440	960	766
1986	Mid-America Packaging	Crown Zellerbach (Gaylord Container)	716	716	260
1986	Stone Container	Jacksonville Kraft	490	490	112
1986	Jefferson Smurfit	Mobil (Container Corp. subsidiary)	1,270	1,903	1,139[2]
1986	Temple-Inland	Owens-Illinois (Orange mill and box plants)	400	400	228[2]
1986	Stone Container	Champion International (Brown Systems Group)	1,027	1,027	426
1985	Mid-America Packaging	Weyerhaeuser (Pine Bluff mill)	112	112	28
1985	Simpson	Champion International (Tacoma mill)	288	372	27
1984	Boise Cascade	Sonat (remaining 50% interest in Boise Southern)	340	652	195[2]
1984	Georgia-Pacific	St. Regis (Monticello mill and box plants)	578	578	375[2]
1983	Stone Container	Continental Group (Brown Systems Group)	1,315	1,315	509
	Total acquisitions completed—14 transactions		8,788[2]	10,337	5,663[2]

[1] Includes linerboard, corrugating medium, and kraft paper.
[2] Includes timber assets.

Source: Morgan Stanley & Co.

of incremental capacity to an existing machine, and they can be installed relatively quickly. About half of the 69 existing unbleached kraft paperboard machines in the U.S. are equipped with high-pressure press sections. Eventually, most machines could be equipped with such presses, indicating that another 700,000 to 1.0 million tpy of new incremental capacity could come from such rebuilds.

As previously noted, several mills are upgrading their machines by installing top formers to improve sheet quality. These projects also may add incremental capacity. About 17 U.S. linerboard mills have incremental capacity expansion projects under way that will add 50,000 tpy or more of capacity during the 1988-91 period.

Another potential source of additional linerboard capacity is the shift of swing machines away from kraft paper to linerboard production. The kraft paper market has declined since 1979 because of the penetration of plastic bags in the grocery sack market and because of sluggish shipments of multiwall sacks. Plastic bags have captured nearly 50% of the 25-billion-unit grocery bag market, and continued market penetration is expected. Total kraft paper production dropped 16% (630,000 tons) between 1979 and 1986, and shipments declined another 6.9% (228,000 tons) in 1987.

As a result of these market losses, a substantial portion of kraft paper capacity was shifted to white paper production by such companies as Champion International Corp., International Paper, and Georgia-Pacific. About 11 swing kraft paper/linerboard machines are still in operation, accounting for about 13% of kraft linerboard production and 30% of kraft paper production. Any conversion of this swing capacity to full-time linerboard production would add proportionally more linerboard capacity, because capacity increases an estimated 20% when paper production is converted to linerboard.

MAJOR U.S. LINERBOARD EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Announced/completed			
Champion International	Roanoke Rapids, N.C.	50	1988
Georgia-Pacific	Monticello, Miss.	177	1988
Jefferson Smurfit	Fernandina Beach, Fla.	80	1988
Union Camp	Montgomery, Ala.	142	1988
Willamette	Campti, La.	50	1988
International Paper	Vicksburg, Miss.	83	1989
Macon Kraft	Macon, Ga.	70	1989
Temple-Inland	Rome, Ga.	176	1990
	Orange, Tex.	90	1989
Weyerhaeuser	Springfield, Ore.	30	1989
	Valliant, Okla.	30	1990
Jefferson Smurfit	Jacksonville, Fla.	90	1990
Gaylord Container	Antioch, Calif.	140	1990
	Bogalusa, La.*	350	1990
Green Bay Packaging	Morrilton, Ark.	125	1990
	Green Bay, Wis.	n.a.[1]	1990
MacMillan Bloedel	Pine Hill, Ala.	70	1991
Great Northern Nekoosa	Cedar Springs, Ga.	90	1991
Mead	Mahrt, Ala.*	150-200[2]	1991
Packaging Corp. of America	Counce, Tenn.	72	1991
Union Camp	Savannah, Ga.*	200 (net)[3]	1991
Kenaf of North America	Muskogee, Okla.	266**	1991
Proposed			
Daishowa/Trans-Rim	Stockton, Calif.	350**	1992
Packaging Corp. of America	Counce, Tenn.	125	1991-92
Weyerhaeuser	Valliant, Okla.	75	1992
	Springfield, Ore.	135	1992
Jefferson Smurfit	Fernandina Beach, Fla.	215	1992
International Paper	Gardiner, Ore./Pineville, La.	240	1991-92

* = New machine.
** = Recycled.
n.a. = Not available.

1. Rebuild of semichemical medium machine to make linerboard using non-kraft process.
2. New Mead machine is designed to produce 420,000 tpy of clay-coated kraft board (mainly for folding carton use), but initial production may be 40% to 50% linerboard.
3. Net capacity increase after installation of new 460,000-tpy linerboard machine and shutdown of two older machines (one of which makes kraft paper).

Greater use of high-performance linerboard could also increase linerboard capacity. These high-strength linerboard grades use less fiber and have lower basis weights. Several companies including Great Northern Nekoosa (Nekoosa Packaging), Stone Container, International Paper, Weyerhaeuser, and Union Camp currently produce grades of high-performance linerboard and corrugating medium.

In high-performance packaging, a minimum 90-lb ring-crush board (with a nominal 45-lb basis weight) could substitute for 55-lb linerboard, and a minimum 115-lb ring-crush board (nominal 56-lb basis weight) could be used in place of 69-lb linerboard to achieve the same compression strength. Ring crush for normal 42-lb linerboard in the U.S. averages around 75 lb, according to a private survey conducted by one company.

Despite historical Rule 41 requirements, use of this containerboard has grown because of the obvious cost savings. Also, many boxes do not have to comply with freight regulations, either because they are shipped by private or contract carriers or because of their design or end use (including half-slotted trays, produce boxes that carry their own certificates, meat and poultry boxes, and displays).

INDUSTRY RESTRUCTURING

The U.S. linerboard industry went through a major period of consolidation during the past five years because of its earlier poor financial results. Some large, diversified companies (Continental Group, Owens-Illinois Inc., and Mobil Corp.) with minor nonstrategic interests in the linerboard industry sold their operations. Other companies became available (St. Regis and Crown Zellerbach) because of attacks by corporate raiders. At the same time, some companies (Stone Container, Jefferson Smurfit Corp., and Gaylord Container) used leveraged financing techniques to take advantange of low asset values and to significantly expand their positions in the linerboard industry.

According to Thomas P. Clephane of Morgan Stanley & Co., about 8.8 million tons of containerboard/kraft paper capacity changed ownership (31% of total industry capacity) in 14 transactions during the 1983-88 period. Stone Container's multiple acquisitions included Continental Group's linerboard/kraft paper operations for $509 million, most of Champion International's unbleached mills for $426 million, Jacksonville Kraft for $112 million, and Southwest Forest Industries for $766 million. Jefferson Smurfit and a Morgan Stanley investment group acquired Container Corp. of America from Mobil for $1.14 billion. And Gaylord Container acquired the following: a kraft paper mill from Weyerhaeuser in 1985, the former Crown Zellerbach containerboard division in 1986, and Louisiana-Pacific's Antioch, Calif., mill in 1988.

Some major established paper companies also expanded their positions in the industry. Great Northern Nekoosa significantly increased its level of integration with containerboard mills and box converting plants when it purchased Owens-Illinois' Forest Products Div. for $1.17 billion in 1987. Major mill purchases were also made by Georgia-Pacific (St. Regis's Monticello, Miss., mill) and Boise Cascade Corp. (remaining 50% of the De Ridder, La., mill from Sonat). Temple-Inland purchased O-I's Orange, Texas, mill in 1986, and it constructed a new recycled linerboard mill in Ontario, Calif., in 1985.

The only major foreign company investment in the U.S. linerboard industry was Pratt Pty. Holdings' purchase of the former Georgia Kraft Co. mill in Macon, Ga., for an estimated $272 million. The Australian company also acquired about six box plants. The sale of the Macon mill was part of the dissolution of the Georgia Kraft joint venture between Temple-Inland and Mead. Temple-Inland purchased Georgia-Kraft's Rome, Ga., linerboard mill, and Mead purchased the Mahrt, Ala., mill to focus on producing coated kraft board.

These consolidations have actually increased the competitive environment in the containerboard and corrugated box industry. Moreover, three of the top five producers in 1988 were not in the top five in 1982.

Many of the acquisitions were made at extremely attractive prices. For example, the cost per daily ton of capacity for Stone Container's acquisitions was $137,000/daily ton for the Continental Group operations and $147,000/daily ton for Champion's unbleached mills. Smurfit/Morgan Stanley paid $212,000/daily ton for Container Corp. of America. (These figures include timber, box plants, and other paper/board grades in the total purchase price.)

Improving industry profitability caused asset values to rise. Great Northern Nekoosa paid close to $400,000/daily ton for its later acquisition of O-I's Forest Products Div., but this also reflected the quality of assets involved.

As a result of improved market conditions and aggressive cost cutting, the acquisition strategy of companies such as Stone Container and Jefferson Smurfit paid off dramatically. Smurfit estimated that it reduced CCA's expenses by $240 million in 1987-88. CCA's profit in 1988 reached about $128 million after taxes—up from only $30 to $40 million in 1984-85. From a break-even profit in 1985, Stone Container earned $342 million in 1988. These two companies have rapidly paid down debt incurred during the highly leveraged acquisitions. In addition, Stone Container

HISTORY OF EASTERN U.S. CONTAINERBOARD PRICES, 1972-40

($/short ton)

Effective date of price changes	Linerboard (42-lb)	Semichemical medium (26-lb)
Sep. 1, 1972	$130.00	$123.00
Oct. 1, 1963	127.50	120.00
Apr. 1, 1962	122.50	115.00
June 15, 1961	114.75	—
Mar. 15, 1961	—	106.00
Nov. 15, 1961	—	110.00
Nov. 1, 1960	—	119.25
Apr. 1, 1956	127.50	132.50
Sep. 1, 1953	122.50	127.50
Jan. 1, 1951	117.50	122.50
Nov. 1, 1950	112.50	117.50
Aug. 1, 1950	105.00	110.00
May 17, 1949	100.00	105.50
Feb. 1, 1948	105.00	—
Mar. 1, 1947	—	110.75
Feb. 1, 1947	100.00	100.00
Sep. 1, 1946	—	82.50
Apr. 1, 1946	74.00	—
Oct. 1, 1945	66.00	—
Jan. 1, 1944	—	77.00
Apr. 1, 1943	63.00	74.00
Jan. 1, 1943	—	68.50
Nov. 1, 1941	—	60.00
July 1, 1941	60.00	57.50
May 1, 1941	55.00	—
Apr. 1, 1941	—	53.00
Jan. 1, 1940	52.50	50.00

Source: *Pulp & Paper Pricebook.*

U.S. PRICES FOR UNBLEACHED KRAFT LINERBOARD

(42-lb, eastern U.S.)

Year	$/short ton	$/1,000 ft²
1988		
4Q	$410*	$8.61
3Q	410	8.61
2Q	410	8.61
1Q	380	7.98
1987		
4Q	$380	7.98
3Q	350/380	7.35/7.98
2Q	350	7.35
1Q	350	7.35
1986		
4Q	320	6.72
3Q	310/320	6.51/6.72
2Q	280/290	5.88/6.09
1Q	260*	5.46
Year-end		
1985	250/260*	5.23/5.46
1984	320/350	6.72/7.35
1983	290	6.09
1982	250*	5.25
1981	270*	5.67
1980	270	5.67
1979	250	5.25
1978	220	4.62
1977	185*	3.89
1976	205*	4.31
1975	195	4.10
1974	195	4.10
1973	145	3.05
1972	130	2.73
1971	127.50	2.68
1970	127.50	2.68

Zoned discounts. Since early 1985, zoned rebates have been offered based on shipping distance from mills. Because most linerboard mills are located in the South, net transaction prices in parts of the Midwest and Texas have been about $10/ton below list and $20/ton in the Southeast. Before 1985, the rebates were $5 and $10/ton respectively.

A premium of $10/ton on linerboard west of the Rockies disappeared at the end of 1985. During 1980-81, western linerboard sold at a $30/ton premium due to high chip costs.

Basis weight differentials. Based on the current 42-lb list price of $410, upcharges for other weights were as follows: 26-lb, plus $50 to $55/ton; 33-lb, plus $25 to $30/ton; 38-lb, plus $5 to $10/ton; 69-lb, same as 42-lb; 90-lb, plus $10/ton.

Specialty grades. New list price for 42-lb mottled white linerboard is $525, with 33-lb ranging from $575 to $595 and 69-lb from $500 to $510. Upcharge for wet-strength grades is about $20/ton.

* = Indicates some discounting from transaction levels.

acquired a foothold in the Canadian and European containerboard and corrugated box markets with its $2.2-billion acquisition of Consolidated-Bathurst Inc. in early 1989 (but that is proving to be a drag on Stone Container's earnings due to the sharp downturn of the newsprint market).

Despite recent merger activity, the U.S. industry is still fragmented with 22 individual linerboard producers. The five largest producers account for about 45% of U.S. linerboard capacity (vs 34% in 1980), and the ten largest have approximately 70% of the market (vs 58% in 1980). Stone Container, now the largest U.S. producer with a 14% market share, rose from No. 16 in 1980. Four new companies emerged among the ten largest producers during this time span, while five disappeared from the industry altogether.

The industry's level of integration has also increased. Integrated producers have assumed larger market shares of the corrugated box market by acquiring independent converters. The most dramatic example of this trend was Great Northern Nekoosa's purchase of both a large independent converter (J&J Corrugated Box) and O-I's Forest Products Div. Prior to these acquisitions, the company's Great Southern Div. was completely nonintegrated. Other companies such as Weyerhaeuser and Macon Kraft have also acquired independent converters. Currently, the largest net sellers of linerboard to independent converters are International Paper, Great Northern Nekoosa, Union Camp, Stone Container, Macon Kraft, and Gaylord Container (with the completion of a major expansion program in 1990).

INTERNATIONAL MARKETS

The U.S. is the world's largest linerboard producer and exporter. Total world linerboard production is estimated at about 38 million tons annually—26 million tons of kraft linerboard and 12 million tons of recycled linerboard. World kraft linerboard exports are estimated at about 5 million tons, of which the largest producers are the U.S., Sweden, Canada, Finland, and Brazil.

U.S. linerboard exports in 1988 remained flat at about 2.3 million short tons, slightly below the record 2.5 million tons exported in 1980. Export shipments to People's Rep. China—the largest purchaser from the U.S. in 1987—declined approximately 44% in 1988 to 158,626 tons. U.S. exports to the rest of the world rose 5.6%. With the exception of People's Rep. China, the export trend reflected strong demand for boxmaking materials from the world's major regional markets. Kraft linerboard exports from the ten major producing countries rose 6.1% to about 5.1 million tons.

Western Europe. U.S. exports to western Europe rose by 2.2% in 1988 to 609,750 tons, but imports from Brazil, which enter the European Community (EC) duty-free, jumped 66% to 308,463 tons. U.S. exports to Europe have declined about 50% since 1980. Although European box shipments remained strong in 1988—up about 6%—Nordic and Brazilian kraft linerboard suppliers as well as local testliner producers strengthened their market positions. Shipments from Sweden to western Europe rose 5.0% to 1.17 million tons, and shipments from Finland increased 8.3% to

274,000 tons. Total western European kraft linerboard imports from ten major supplying countries (excluding South Africa and the U.S.S.R.) rose 8.8% in 1988 to 3.0 million tons, according to API's annual export report.

Kraft linerboard appears to have held its market position in 1988 relative to test linerboard. However, the share of the EC containerboard market held by testliner has increased to about 22% in recent years from 17% in 1980. Kraft linerboard's share of the market declined from about 25% at the beginning of the decade to around 20%.

Numerous kraft linerboard suppliers and growing local competition from testliner producers have made the European market highly competitive. Prices crashed in 1985 due to high inventories and the strong dollar. Transaction levels fell below the $333/metric ton minimum antidumping price (in the case of 175-g+ board) that was imposed by the EC in 1983 after an earlier market downturn. Prices as low as $260 to $290/metric ton c.i.f. made it difficult for U.S. producers to compete on both economic and legal grounds. Prices began to recover in the second quarter of 1986, and they strengthened throughout 1987.

The $45/ton increase in the spring of 1988 took U.S. list levels in Europe to about $525/$550/$570 for heavy (175-g+), medium (150-g), and lightweight (125-g) linerboard before 6% duty. However, an attempt by U.S. producers to push through another $40/ton price increase in the spring of 1989 was unsuccessful due to both the stronger dollar and the failure of a domestic price increase.

Nordic producers were unsuccessful in raising their local currency list prices in Europe, which had also been in effect since the spring of 1988. The Nordic price for heavyweight linerboard in Europe is DM1,095/metric ton free-delivered or DM1,035 on a c.i.f. basis. (At DM1.9/US$, the price is equal to $545/ton, which compares to a list price from U.S. suppliers of $557/ton for heavyweight linerboard after addition of 6% duty.) Actual transaction prices in Europe have eroded since late 1988.

Although no large, new kraft linerboard machines have been announced in Europe, several major producers have rebuilds under way or recently completed, including Cellulose du Pin (France), ASSI (Sweden), and Portucel (Portugal). Testliner and other recycled containerboard capacity is expected to increase at an even faster rate, with plans for several new machines and rebuilds along with reactivation of idle capacity. This will probably limit growth of U.S. linerboard exports to western Europe. Nordic mills also increased capacity to produce bleached or white-top linerboard for better graphic display. Sweden's total production of white linerboard grades in 1988 jumped 9.2% to 366,460 tons, while Finland's exports of such grades jumped nearly 40% to 130,000 tons.

Far East. The Far East continued to be the dominant importer of U.S. linerboard in 1988, according to the API export report (based on U.S. Dept. of Commerce data). U.S. exports to the region—excluding People's Rep. China—advanced 4.3% to 660,530 tons. Exports increased significantly to Hong Kong, Taiwan, and Rep. Korea, but exports to Japan were off 1.9% to 163,756 tons, in spite of higher linerboard consumption in that country and the lower value of the U.S. dollar relative to the yen. The U.S. is the largest kraft linerboard exporter to the Far East, followed by Canada, which shipped 106,000 tons to the region (including People's Rep. China) in 1988.

Prices in the region tend to be volatile because some U.S. mills use it as a dumping ground during periods of domestic oversupply. For example, as irregular sellers entered the market with low spot offers in 1985, price levels for lightweight linerboard dropped to between $260 and $270/ton. Prices staged a strong recovery during the next two years, and in spring of 1988 U.S. producers announced new list prices of $525/$550/$570 per metric ton c.i.f. for markets such as Singapore and Malaysia. (Prices in Hong Kong and Taiwan are about $10 to $15/ton less due to lower shipping costs.) Transaction levels in the region have eroded since the last quarter of 1988.

Strong economic growth among industrializing Asian countries should lead to growing markets for U.S. linerboard exports. However, some countries have substantially expanded their testliner capacity, and part of the output will be exported to other countries in the region. Testliner capacity in Taiwan, Rep. Korea, and Indonesia will reach

MANUFACTURING COST AND PROFITABILITY TRENDS FOR AVERAGE U.S. SOUTHERN LINERBOARD MILL

($/short ton)

	1988	1987	1986	1985	1984
Average price[1]	$403	$361	$295	$274	$320
Fiber	107	103	98	106	113
Energy	23	24	24	32	34
Labor	36	36	36	35	35
Chemicals	14	14	14	15	15
Other	18	17	16	17	17
Delivery	33	32	32	32	32
Total variable costs	231	224	220	237	247
Depreciation	26	25	24	23	21
Interest	19	18	18	17	15
Overhead	16	16	16	15	15
Total costs[2]	292	283	278	292	299
Pretax profit[1]	111	78	17	(18)	21

Sources: 1. *Pulp & Paper* estimates. 2. Cost estimates from Resource Information Systems Inc. (RISI), *World Kraftliner Study.*

EXPORTS OF KRAFT LINERBOARD BY MAJOR SUPPLYING COUNTRIES

(000 short tons)

Country	1988	1987	1986	1985	% change 1988/87
U.S.	2,281	2,295	2,177	1,807	-0.6%
Sweden	1,263	1,196	1,111	1,147	5.6
Canada	323	311	347	290	3.8
Finland	290	284	244	262	2.1
Brazil	448	234	208	154	91.5
Portugal	132	126	149	151	4.8
Austria	126	122	109	102	3.3
Norway	60	55	42	20	9.1
Spain	37	43	39	39	-5.1
Other	138	—	—	—	—
Total	5,098	4,666	4,426	3,972	9.2

Source: American Paper Institute—International Div., "Exports of Kraft Linerboard & Corrugating Material."

nearly 3.9 million metric tpy by 1990—more than double the level in 1987—said William A. Gleason, president of Pacific Forest Resources Inc. at *Pulp & Paper*'s Third International Unbleached Kraft Conference in fall of 1988. Taiwan alone is scheduled to add two major testliner machines in 1988 and five more machines in 1989.

Japan. In 1988, U.S. linerboard exports to Japan fell 1.9% to 163,756 tons, despite relatively healthy domestic corrugated box shipments and government policy aimed at increasing imports. The Japanese market has suffered from domestic overcapacity, and the price of K_2 linerboard (the most common grade, containing about 40% wastepaper) has flattened or declined for several years despite healthy corrugated box production. This keeps pressure on export prices, making Japan a less attractive market for U.S. suppliers. The price of heavyweight kraft linerboard in Japan has fallen below that of other major export markets.

Prices in the Japanese market tend to be more stable because of special quality requirements and long-term business relationships that make it difficult for spot sellers to enter the market. Weyerhaeuser, the largest exporter to Japan, set up a warehouse system and sells liner in yen delivered to Japanese customers. According to *Japan Pulp &*

U.S. KRAFT LINERBOARD EXPORTS BY WORLD REGION

(000 short tons)[1]

Year	Total[2,3]	Western Europe	Far East/ Oceania	People's Rep. China	Central America/ Mexico	South America	Caribbean/ other islands	Canada	Middle East	Africa
1988	2,281	610	661	159	364	132	64	45	154	94
1987	2,295	597	633	284	275	123	56	44	145	91
1986	2,177	636	616	182	265	130	68	42	142	87
1985	1,807	511	460	110	250	122	56	40	137	107
1984	2,058	712	495	110	321	135	66	37	143	110
1983	2,255	761	501	166	276	110	74	48	151	108
1982	1,886	644	372	111	264	133	54	48	112	149
1981	1,973	637	357	174	275	131	48	39	127	185
1980	2,527	919	411	319	337	130	46	26	99	241
1979	1,645	711	264	11	278	110	45	55	101	70
1978	1,540	623	139	3	270	146	72	39	107	80
1977	1,428	607	120	22	238	133	67	30	118	93
1976	1,419	618	116	—	235	91	63	73	112	111
1975	1,224	522	73	—	171	121	38	65	142	91
1974	1,743	927	116	5	204	139	52	41	107	150
1973	1,646	862	141	17	237	138	43	19	79	108
1972	1,877	1,073	152	—	244	137	58	19	99	96
1971	1,966	1,166	142	—	247	148	44	17	100	101
1970	1,761	1,016	104	—	238	148	40	19	95	101

1. Includes "bleached" linerboard exports of 100,000 to 140,000 tons in recent years (most of this is believed to be unbleached mottled board that has been misclassified).
2. Totals may include some unallocated shipment not shown in regional breakdown; 57,000 tons were exported to the U.S.S.R. and eastern Europe in 1977.
3. Some variation exists between Dept. of Commerce and API production-for-export statistics, which were as follows (000 tons): 1988—2,296; 1987—2,303; 1986—2,246; 1985—1,830; 1984—2,086.

Source: American Paper Institute (from Dept. of Commerce data).

Paper magazine, in 1988 the largest North American linerboard exporters to Japan were Weyerhaeuser (80,000 metric tons), International Paper (40,000 tons), Eurocan Pulp & Paper Co. (34,000 tons), and Stone Container (25,000 tons).

U.S. linerboard exports to Japan are expected to increase because of uncompetitive production costs in that country resulting from high fiber and energy costs. In addition, Japanese linerboard mills are currently running near full capacity, with estimated 1988 operating rates of 91%—up from as low as 70% in the mid-1980s—and no significant new capacity planned. As a result, Japanese linerboard imports (which totaled 200,000 metric tons from all sources in 1988) could expand significantly in the early 1990s, and U.S. suppliers would be the main beneficiaries. However, Taiwan could emerge as an important supplier of testliner to Japan.

People's Rep. China. The wild card in the U.S. linerboard export picture is People's Rep. China, which was the single largest importing country prior to 1988. U.S. shipments in 1987 increased 54% to 284,000 tons—second only to the record 319,000 tons shipped to that country in 1980 when it began making major purchases. Since then, People's Rep. China has bought in surges, with shipments during the weakest years dropping to around 110,000 tons. These surges reflect the country's inventory cycles and its attempts to buy at the lowest prices in the U.S. market.

Orders from People's Rep. China fell off in the second half of 1987, and they remained weak through the first half of 1989. The civil unrest that paralyzed the country in mid-1989 led most observers to expect a disruption in trade. However, some observers now expect orders to increase in the second half of 1989 due to depleted inventories and soft U.S. domestic market prices. The long-term outlook for U.S. linerboard exports to People's Rep. China is positive because of that country's strong economic growth (recently running at about 9%/year), its drive to increase exports, and its limited wood resources. Most of the kraft linerboard imported into People's Rep. China is used for packaging export products. The country imports linerboard through China Pack and Ministry of Light Industries. International Paper is believed to be the largest U.S. exporter to the country.

Latin America. U.S. linerboard exports to Latin America rose 11.8% in 1988 to 55,508 short tons. Mexico represents the largest market; it increased U.S. imports by 13.7% to 57,365 tons. Shipments to South America rose 7.2% to

U.S. EXPORT LINERBOARD PRICES VS TESTLINER IN NORTHERN EUROPE

Year	U.S. kraft linerboard c.i.f., duty unpaid 175 g + ($/metric ton)	+ 36 lb ($/short ton)	Testliner no. 2 delivered Germany 150 g (DM/metric ton)
1989			
4Q	$440/480*	$(399/445)	DM800/830
3Q	480/490*	(435/445)	800/820
2Q	500	(453)	800/820
1Q	500	(453)	810/820
1988			
4Q	500*	(453)	790/820
3Q	515	(467)	750/780
2Q	530	(481)	640/720
1Q	485	(440)	660/680
1987			
4Q	485	(440)	650/670
3Q	485	(440)	650/670
2Q	440	(399)	640/660
1Q	405	(367)	610/630
1986			
4Q	405	(367)	620/650
3Q	370/405	(336/367)	660
2Q	370	(336)	700
1Q	290/310	(263/281)	700
Year-end			
1985	270/290	(245/263)	750
1984	370/405	(336/367)	890
1983	333*	(362)*	720
1982	300*	(272)*	670
1981	415	(376)	780
1980	380	(345)	750/925
1979	375	(340)	770
1978	280	(254)	560
1977	230*	(209)*	—
1976	255*	(231)*	—
1975	310*	(281)*	—
1974	350	(317)	—
1973	245	(222)	—
1972	170	(155)	—
1971	137	(125)	—

* = Some tonnage being sold below main transaction price levels.

Source: *Pulp & Paper Week.*

WESTERN EUROPE'S KRAFT LINERBOARD SUPPLIERS

(000 short tons)

	1988	1987	1986	1985
Sweden	1,170	1,115	1,035	1,040
Finland	275	254	226	194
Norway	58	45	35	19
Total Nordic	1,503	1,413	1,295	1,253
U.S.	610	597	636	511
Canada	157	139	133	105
Austria	121	117	103	95
Iberia	n.a.	164	182	178
France	130	128	118	86
Brazil	308	186	156	108
U.S.S.R.	n.a.	n.a.	86	19
South Africa	n.a.	n.a.	69	15

n.a. = Not available.

131,800 tons. Another 64,000 tons were shipped to the Caribbean and other islands. U.S. export prices to Latin America tend to be stable because of long-term contracts with major customers, such as banana and coffee growers. Several U.S. companies, including Jefferson Smurfit, Stone Container, and Union Camp, operate containerboard mills or box plants in the region, which also stabilizes prices.

The U.S. is the only foreign supplier of any consequence to these markets. With its economy and domestic consumption declining in 1988, Brazil increased its kraft linerboard exports by more than 90% to a record 448,000 short tons, yet only a small portion was exported to other Latin American countries. Klabin, the largest producer in Brazil, recently announced plans to install a new export-oriented machine with capacity of around 200,000 metric tpy for completion in 1992. (This will replace some existing capacity for a net gain of about 50,000 tpy). In the future, countries such as Brazil, Chile, and New Zealand—each with large, fast-growing softwood resources—will probably be big competitors in the linerboard export market.

OUTLOOK

The U.S. linerboard industry has probably reached the peak of its current market cycle. Assuming an economic slowdown but no recession, corrugated box shipments will probably grow about 2% in 1989 and 1% in 1990 before rebounding in 1991. With capacity growing at a faster pace than demand, linerboard mill operating rates are expected to drop to 93% in 1989 and possibly to 91% in 1990. This forecast assumes some moderate growth in exports, as long as the U.S. dollar stays weak.

Even in this relatively optimistic scenario, domestic price levels could erode. As noted earlier, significant new capacity will be added by Gaylord Container in 1990, followed by Union Camp and Mead in 1991. Industry profit margins have already eroded because producers have failed to push through a linerboard or corrugated box price increase since spring of 1988. (For a long-term supply/demand forecast, see *Containerboard and Corrugated Containers Market Outlook to the 21st Century*, written by Kenneth E. Lowe and published by *Pulp & Paper* Forecaster Services.)

The outlook for the U.S. linerboard industry is favorable for several reasons: low production costs relative to other parts of the world, increasing industry concentration, introduction of higher-value-added products, and lack of strong competition from plastics or other competing packaging materials. U.S. linerboard exporters, however, could face stiffer competition in world markets from nontraditional kraft linerboard producers such as Brazil, Chile, New Zealand, and South Africa, as well as from local testliner suppliers.

U.S. EXPORT LINERBOARD PRICES IN ASIA

Year	Southeast Asia 125 g ($/metric ton c.i.f.)[1]	People's Rep. China ($/metric ton f.a.s.)[2]	Japan 175 g+ ($/metric ton c.i.f.)[3]	Japan Domestic K_2 (¥/kg delivered)[4]
1989				
4Q	$510	n.a.	$400/425	¥75
3Q	530	n.a.	425	75
2Q	530/540	$350	425	75
1Q	520/530	350	425	78
1988				
4Q	520/530	351	450	78
3Q	550/570	355	450	78
2Q	550/570	361	450	78
1Q	530	n.a.	n.a.	n.a.
1987				
4Q	530	422	450	¥80
3Q	500/530	391	420/450	80
2Q	500	367	420	80
1Q	485/500	358	390	78
1986				
4Q	440/455	332	380	75
3Q	420/435	308	370	80
2Q	350	219	350	85/87
1Q	280	203	320	85
Year-end				
1985	270*	208	—	85
1984	380	326	—	124/125
1983	365	222	—	118/120
1982	—	207	—	119/129
1981	—	280	—	133/140
1980	—	326	—	137

n.a. = Not available.

1. Levels in Hong Kong typically $10/ton lower due to freight cost.
2. Average value per ton of exports calculated from Dept. of Commerce data.
3. Prices from regular U.S. suppliers.
4. K_2 contains about 40% wastepaper and has become the most important liner grade made by Japanese mills.

Source: *Pulp & Paper Pricebook.*

1988 KRAFTLINER EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

	Exporters				
Major importers	**U.S.**	**Canada**	**Sweden**	**Finland**	**Norway**
EUROPE					
Austria	—	—	16	1	—
Belgium	7	84	49	12	4
Denmark	—	—	78	20	1
Finland	2	7	23	—	—
France	11	—	171	27	—
Germany, Fed. Rep.	107	4	198	58	18
Greece	3	—	9	4	—
Ireland	—	—	46	7	—
Italy	93	—	53	6	—
Netherlands	35	—	80	23	4
Norway	1	—	26	4	—
Spain	57	—	4	14	—
Sweden	5	—	—	5	—
Switzerland	—	—	34	4	—
U.K.	206	45	270	61	18
Other Europe	26	2	7	5	7
Total Europe	553	142	1,064	251	52
NORTH AMERICA					
Canada	41	—	—	—	—
U.S.	—	46	—	—	—
Total North America	41	46	—	—	—
ASIA/AUSTRALASIA					
Australia	33	—	11	—	—
China, People's Rep.	144	20	16	—	—
Hong Kong	164	6	—	—	—
Iran	—	—	—	—	—
Israel	54	—	3	1	—
Japan	149	39	—	—	—
Korea, Rep.	43	13	—	—	—
Malaysia	32	—	1	—	—
Philippines	73	3	—	—	—
Singapore	39	8	2	1	—
Taiwan	52	5	—	—	—
Other Asia/Australasia	99	8	16	5	1
Total Asia/Australasia	882	102	49	8	1
LATIN AMERICA					
Colombia	52	—	—	—	—
Costa Rica	—	—	—	—	—
Ecuador	—	—	—	—	—
Guatemala	38	—	—	—	—
Mexico	52	—	—	—	—
Panama	—	—	—	—	—
Other Latin America	366	1	4	—	—
Total Latin America	508	1	4	0	0
AFRICA					
Egypt	37	—	1	1	1
Morocco	—	—	13	1	—
Nigeria	3	—	—	—	—
South Africa	9	—	—	—	—
Other Africa	36	1	15	—	—
Total Africa	85	1	29	2	1
WORLD TOTAL	2,069	292	1,146	261	54

Source: *Pulp & Paper International*, Annual Review, July 1989.

Paperboard:

CORRUGATING MEDIUM

Corrugating medium is used to form the central or middle fluting material in corrugated containerboard. It is first fluted or corrugated in a corrugator, then faced on both sides with linerboard to form the rigid combined board.

Corrugating medium is made from both semichemical pulp and recycled fiber. In 1988, 75% of U.S. corrugating medium was made from semichemical pulp furnish (which typically contains some recycled fiber). The remaining 25%, called "bogus" medium, was produced from 100% recycled fiber. Basis weights of corrugating medium are 22, 26, 31, 33, 36, and 40 lb/1,000 ft^2.

U.S. STATISTICS FOR CORRUGATING MEDIUM

(000 short tons)

	1989e	1988	1987
Production			
Semichemical	5,719	5,664	5,536
Recycled	1,780	1,823	1,673
Total	7,499	7,487	7,209
Capacity			
Semichemical	5,987	5,796	5,682
Recycled	1,913	1,850	1,685
Utilization rates, %			
Semichemical	95.5	97.7	97.4
Recycled	93.0	98.5	99.3
Imports[1]	145	140	129
Exports	65	55	64
Apparent U.S. consumption			
000 tons	7,579	7,572	7,274
lb/capita	62.0	61.9	60.2
000 tons/$ billion real GNP	1.91	1.92	1.91

e = Estimate.

[1] Dept. of Commerce data.

Sources: American Paper Institute, *Pulp & Paper* estimates.

Semichemical corrugating medium is made primarily from hardwoods, but some mills find it difficult to pulp certain species such as white oak. Western mills sometimes use softwood species. Softwood sawdust is also used. Semichemical medium is normally manufactured on conventional fourdrinier paper machines, but a small percentage is produced on cylinder board machines. A couple of mills in Wisconsin and Virginia produce medium using twin-wire formers.

Semichemical medium contains some long fiber to improve paper machine runability and to lessen the tendency of medium to crack and break upon corrugating. The principal sources of long fiber are waste corrugated containers and new double-lined kraft cuttings. The amount of secondary fiber used varies from zero to 50%, but average wastepaper content is close to 33%. In some cases, screenings from kraft mills or kraft softwood pulp are used as the source of long fiber.

Semichemical pulping combines a mild chemical pulping of chips prior to mechanical defibrating and produces a fairly high yield—60% to 80%—as well as an intermediate-strength level. Neutral sulfite semichemical (NSSC), developed in the 1920s, was the original semichemical pulping process. Sodium sulfite and soda ash were used, and pulping was initially performed using rotary batch digesters. Most semichemical mills now use continuous digesters, and they have shifted from NSSC to the newer carbonate-base and green-liquor semichemical pulping processes.

More than 60% of U.S. semichemical mills have shifted from NSSC to the Owens-Illinois nonsulfur and green-liquor processes. These processes, developed since the 1960s, are simpler and less capital-intensive, and they have fewer pollution problems. The O-I process uses soda ash (sodium carbonate) and a small amount of caustic soda, and it is adaptable to existing stand-alone semichemical mills with only minor equipment modifications.

Green-liquor semichemical pulping uses kraft green liquor; therefore, the process can be used only in combination with a kraft mill. Such cross-recovery reduces chemical processing and recovery and minimizes capital costs. Both the O-I and green-liquor processes produce a semichemical pulp comparable in quality to NSSC, except for a darker color. Wetting agents, however, must be added to the refined stock to control glue absorption in the finished board.

Mills that produce bogus medium use mostly old corrugated containers as a fiber source. Because waste corrugated containers contain foreign materials (tape, hotmelts, latexes, asphalt, waxes, etc.), mills use cleaning equipment to remove contaminants from the stock. Additives such as modified starches and gums are used to improve the strength, or concora, of bogus medium. At 5 to 10 lb/ton, these additives can improve concora by 10% to 20%.

The principal test used to judge the strength of corrugating medium is the concora test. Concora is controlled by refining and through choice of fiber types. Typical concora values for standard basis weights are 60 to 70 lb for 26-lb medium and 70 to 90 lb for 33-lb medium.

Most semichemical medium is produced at 26 lb/1,000 ft^2, but the trend is toward heavier weights. Weights of 36 to 40 lb and higher now account for about 8% of total semichemical production—up from virtually nothing at the beginning of the 1980s. This reflects an industry move toward more performance-oriented corrugated packaging that emphasizes top-to-bottom compression strength in finished boxes. (See Linerboard and Converted Products chapters.) Compression strength requirements can be met using lower-basis-weight linerboard as well as heavier-weight corrugating medium, resulting in reduced fiber costs.

Wet-strength grades have grown in popularity (mainly in 33-, 36-, and 40-lb weights), and now account for about 5% of semichemical medium production. Corrugating medium for conventional uses is not sized. Hard sizing would interfere with starch gluing and result in poor adhesion between liner and medium.

The U.S. has 38 semichemical medium mills, and approximately one-third of total industry capacity is located in the upper Midwest hardwood region. Most Canadian capacity is located in the eastern and Maritime provinces, and some of these mills ship to the northeastern U.S. Recycled medium mills are usually located in major urban areas, near wastepaper supplies and major box markets, giving them an advantage in transportation costs.

PRODUCTION/CAPACITY TRENDS

Virtually 100% of corrugating medium is used in the production of corrugated containerboard. Therefore, production of corrugating medium generally follows production of linerboard. Approximately one ton of medium is used for every 2.16 tons of linerboard in producing corrugated containers. (See Linerboard chapter.)

In 1988, production of corrugating medium rose about 3.9% to 7.5 million tons. Corrugated box shipments rose 3.6% to 308.5 billion ft^2. This discrepancy in growth rates is due to the fact that about 10% of corrugated containers are double- or triple-wall, which tend to use proportionally more linerboard and corrugating medium. In 1988, semichemical medium production rose 2.3% to 5.6 million tons, while recycled medium production jumped 8.9% to 1.8 million tons.

Demand for both semichemical and recycled medium was strong throughout most of 1988, but the market eased late in the year because of lower domestic corrugated box shipments and lower export shipments. Semichemical exports dropped by nearly 30% to 136,000 tons in 1988. However, supply was relatively tight because capacity additions were only incremental. As a result, semichemical

ANNUAL U.S. CAPACITY FOR CORRUGATING MEDIUM

(000 short tons)

Year	Semichemical	Recycled	Total	Change (%)
1990e	6,160	2,123	8,283	4.8%
1989e	5,987	1,913	7,900	3.3
1988e	5,796	1,850	7,646	3.8
1987	5,682	1,685	7,367	3.2
1986	5,557	1,580	7,137	2.9
1985	5,411	1,523	6,934	2.3
1984	5,252	1,524	6,776	1.0
1983	5,156	1,555	6,711	0.4
1982	5,207	1,478	6,685	5.5
1981	4,988	1,349	6,337	1.0
1980	4,946	1,330	6,276	0.3
1979	4,864	1,392	6,256	2.8
1978	4,739	1,343	6,082	1.4
1977	4,661	1,337	5,998	-3.8
1976	4,758	1,476	6,234	4.2
1975	4,536	1,449	5,985	3.5
1974	4,430	1,358	5,788	4.0
1973	4,386	1,178	5,564	6.6
1972	4,155	1,063	5,218	5.6
1971	3,938	1,000	4,938	2.2
1970	3,847	983	4,830	—

e = Estimate.

Sources: American Paper Institute, *Pulp & Paper* estimates.

mills operated close to 98% of capacity for the year, while recycled mills operated near 95%.

Semichemical medium capacity increased at only a 2.0% rate in 1988, according to the American Paper Institute. The supply shortfall was made up with imports and greater use of recycled medium. Imports of medium (mainly from Canada) jumped nearly 11% to 142,000 tons in 1988.

Capacity at semichemical medium mills is expected to increase at a much faster rate than in the past. Between 1986 and 1988, semichemical capacity grew at an average annual rate of 2.3%. Between 1989 and 1991, it will probably grow an average 3.2% annually. No new semichemical medium machines have been announced in the U.S., so all capacity additions will come from machine rebuilds. In 1987, Clinch River Corp. purchased the idle Harriman Paperboard mill at Harriman, Tenn. Following a machine rebuild, the mill now produces 300 tpd of semichemical medium. Other companies that have undertaken major rebuilds include Green Bay Packaging Inc., Virginia Fibre Corp., Mead Corp., and Temple-Inland Inc. Several of these rebuilds include installation of wide-nip presses to improve quality and add incremental capacity.

Recycled medium capacity has increased sharply in recent years, rising about 6.5% in 1987 and almost 10% in 1988. It was expected to increase about 9% in 1989, but in late 1988 Nolichucky Industries Corp. was forced into bankruptcy, resulting in the shutdown of approximately 180,000 annual tons of recycled medium and linerboard capacity at three mills that were previously idle.

Major recycled projects include Stone Container Corp.'s rebuild of a recycled medium machine at Uncasville, Conn., and construction of a new 350,000-tpy greenfield mill by Daishowa America Co. Ltd. and Trans-Rim Enterprises Ltd. at Stockton, Calif. Australia's Pratt Group is installing a rebuilt paper machine at Hartford City, Ind., to produce about 50,000 tpy of recycled medium. Recycled Paper Board Inc. and Valley Converting plan to reopen idle mills. And in 1988, Cascades Inc. converted two newsprint machines at its Niagara Falls, N.Y., mill to recycled medium production. The two machines have capacity for about 80,000 tpy.

PRICES

Prices for corrugating medium slid sharply in the containerboard market downturn of 1985, even though semichemical medium mills continued to run at about 94% of capacity. Semichemical medium prices dropped as low as $230 to $240/short ton in 1985, which was below break-even for many mills. Prices began to firm in 1986, although producers had difficulty restoring their normal $10/ton differential with kraft linerboard. A gap between the two grades of $20 to $30/ton persisted through 1986-87, but since then it has diminished.

Semichemical medium producers last raised prices in March 1988. They implemented a hike of $30/ton to a $400 list, with transaction prices averaging about $390. (The difference between linerboard and medium prices is clouded by the industry practice of offering zoned rebates of $10 and $20/ton based on shipping distance from the mill. As noted earlier, most linerboard mills are located in the Southeast, while medium mills are scattered throughout the U.S. and thus are within a shorter shipping distance of customers.)

Domestic demand for corrugating medium dropped slightly in both the first and second quarters of 1989. Consequently, prices for semichemical medium have weakened, and transaction prices declined to between $370 and $380/ton in the northeastern U.S. by midyear. The softness in semichemical medium prices has been hastened by competitive pressure from smaller recycled mills. Because recycled mills have lower operating rates and wastepaper costs, some semichemical mills have reduced prices to keep orders coming. Additional pressure has come from Canadian medium imports in the Northeast as well as from Mexican imports in the Southwest.

ANNUAL U.S. PRODUCTION OF CORRUGATING MEDIUM

(000 short tons)

Year	Semichemical	Recycled	Total	Change (%)
1988	5,664	1,823	7,487	3.9%
1987	5,536	1,673	7,209	3.9
1986	5,373	1,568	6,941	5.5
1985	5,088	1,486	6,574	0.1
1984	5,169	1,397	6,566	4.6
1983	4,731	1,545	6,276	7.9
1982	4,389	1,427	5,416	3.6
1981	4,717	1,315	6,032	0.5
1980	4,723	1,281	6,004	0.2
1979	4,689	1,301	5,990	2.4
1978	4,439	1,408	5,847	5.4
1977	4,264	1,286	5,550	7.8
1976	4,105	1,040	5,145	14.6
1975	3,702	788	4,490	-15.1
1974	4,175	1,115	5,290	-3.2
1973	4,260	1,204	5,464	10.3
1972	4,010	942	4,952	8.1
1971	3,700	879	4,579	3.7
1970	3,500	916	4,416	—

Sources: American Paper Institute, *Pulp & Paper* estimates.

CAPACITY RANKINGS OF U.S. CORRUGATING MEDIUM PRODUCERS

(000 short tons)

	Company	Annual capacity: Semichemical medium	Recycled medium	Total	Capacity share (%)
1	Great Northern Nekoosa	980[1]	—	980	12.4%
2	Stone Container	680	180	860	10.9
3	Weyerhaeuser	685	—	685	8.7
4	Temple-Inland	205	275	480	6.1
5	Jefferson Smurfit	60[2]	330[2]	390	4.9
6	Mead	390	—	390	4.9
7	International Paper	350	—	350	4.4
8	Willamette Industries	140[4]	145	295	3.2
9	Georgia-Pacific	280[3]	—	280	3.5
10	Packaging Corp. of America	270	—	270	3.4
11	Virginia Fibre	265	—	265	3.4
12	MacMillan Bloedel	250	—	250	3.2
13	Menasha	185	—	185	2.3
14	Weston Paper	150	—	150	1.9
15	Waldorf	—	140	140	1.8
16	Green Bay Packaging	135	—	135	1.7
17	Chesapeake	—	125	125	1.6
18	Manville Forest Products	120	—	120	1.5
19	Gaylord Container	—	115	115	1.5
20	Boise Cascade	110	—	110	1.4
21	Clinch River	105[5]	—	105	1.3
22	Groveton Paper Board	105[6]	—	105	1.3
23	Westvaco	100	—	100	1.3
24	Consolidated Packaging	75	—	75	1.0
25	Grief Board	—	75	75	1.0
26	Dixie Container	—	73	73	1.0
27	Longview Fibre	70	—	70	0.9
28	Cascades	—	70[7]	70	0.9
29	Fairfield	—	60	60	0.8
30	Corrugated Services	—	50	50	0.6
31	Connelly Containers	—	40	40	0.5
32	Newark Boxboard	—	35	35	0.4
33	Menominee	—	30	30	0.4
34	Interstate	—	30	30	0.4

U.S. capacity (1989): 7.900 million short tons
Market share of top 5 companies: 43.0%
Market share of top 10 companies: 63.0%

Note: Other mills that make small quantities of recycled medium include: Cleaners Hanger Co., Cornwall Paper Mills Co., Forestales Caribe Inc., and Specialty Paper Mills Inc.

1. Includes Great Southern Paper and Nekoosa Packaging (717,000 tpy semichemical medium) acquired from Owens-Illinois Inc. in 1987.
2. Includes 50% interest in Container Corp. of America mills (115,000 tpy semichemical and 172,000 tpy recycled medium) acquired in 1986.
3. Includes 50% interest in 170,000-tpy semichemical medium machine at Sonoco Products Co.'s Hartsville, S.C., mill; G-P takes the production.
4. Reflects conversion of medium machine to linerboard at Willamette's Albany, Ore., mill in 1987.
5. New company that acquired and reactivated former Harriman Paper Board mill in Harriman, Tenn., in mid-1988.
6. Owned 31% by Jefferson Smurfit and 69% by SPB Canada; machine operated by James River Corp.
7. Cascades acquired former Nitec Paper mill in Niagara, N.Y., and in 1988 converted two machines to recycled medium.

INDUSTRY STRUCTURE

The corrugating medium market tends to be more competitive and regionalized than the linerboard industry. This reflects a larger number of small producers scattered across the U.S. More than 32 U.S. companies produce semichemical or recycled medium, and the five largest companies account for about 42% of total industry capacity. By contrast, linerboard is produced by 22 companies, of which the five largest have 44% of the market.

The cost profiles of corrugating medium producers show greater range, reflecting wider variation in mill size and fiber furnish costs. About one-third of U.S. semichemical medium capacity is represented by machines that produce 125,000 tpy or less. Two U.S. semichemical machines have capacity to produce over 300,000 tpy each. Nekoosa Packaging Inc.'s Tomahawk, Wis., mill and Mead's Stevenson, Ala., mill are two of the most efficient medium mills. Recycled mills tend to be older and less efficient, but they may have an advantage when wastepaper costs are low.

Corrugated box shipments are expected to rise 1.8% in 1989, followed by a 1.0% increase in 1990. These trends reflect weaker demand in primary manufacturing and industrial production. Total medium production in 1989 is forecast to rise only 1.2% to 7.58 million tons. Semichemical medium output will rise 1.1%, but recycled medium will decline about 3.5%. Typically, when demand weakens for corrugating medium, production of recycled medium drops more severely than semichemical production.

Because of the anticipated rise in recycled medium capacity and the decline in production, recycled mill operating rates are forecast to decline sharply, averaging about 87% in 1989, 83% in 1990, and 84% in 1991. In contrast, semichemical mills are forecast to operate at 95% to 96% capacity in 1989. Rates will drop to about 93% in 1990, then climb back to the 95%-to-96% range in 1991.

The long-term outlook for corrugating medium is bright as long as the trend continues toward higher basis weights and more performance-oriented corrugated packaging. Higher growth in medium capacity, however, may become a problem as more mills install high-pressure presses (see Linerboard chapter) and as several older recycled paperboard mills are reactivated or converted from other grades to medium production. At least two U.S. semichemical medium mills have installed wide-nip presses, and several other projects are planned.

CANADIAN CONTAINERBOARD MARKET

The Canadian containerboard industry (both linerboard and medium, including recycled) is much smaller than the U.S. industry. Canada produces about 2.0 million short tpy, compared with about 25 million tpy for the U.S. This reflects the fact that the Canadian industry serves mainly the domestic market, which has a population of only 25 million and an economy about one-twelfth the size of the U.S. economy. About 90% of the industry's production is integrated forward to corrugated container production.

Canada's containerboard industry developed behind high tariff walls, and many of its facilities are not competitive in size or scale with mills in the U.S. The higher cost structure for the Canadian industry also reflects the fact that linerboard is a fiber-intensive grade, while the growing cycle for wood in northeastern Canada is slow and harvesting and transportation costs are high. Until 1980, a 15% tariff protected the containerboard industry. Under GATT negotiations completed in the late 1970s, tariffs dropped to 6.5% in 1987 for kraft linerboard and 4% for corrugating medium. Staged reductions during the next five years will eliminate the tariffs by 1993.

MAJOR U.S. CORRUGATING MEDIUM EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Announced			
Mead	Stevenson, Ala.	35	1989
Corrugated Services	Forney, Texas	27	1989
Stone Container*	Uncasville, Conn.	60	1989
Temple-Inland	New Johnsonville, Tenn.	33	1989
Pratt Group*	Hartford City, Ind.	70[1]	1990
Great Northern Nekoosa	Tomahawk, Wis.	80	1990
Temple-Inland*	Newport, Ind.	42	1990
Menasha	Otsego, Wis.	60	1991
Virginia Fibre	Riverville, Va.	165	1992
Weyerhaeuser	Valliant, Okla.	55	1992
Weston	Terre Haute, Ind.	60	1992
Proposed			
Jefferson Smurfit*	Fernandina Beach, Fla.	210[2]	n.a.
Daishowa America*	Stockton, Calif.	n.a.	1992

* = Recycled medium.
n.a. = Not available.
1. Installing refurbished paper machine in idle mill to produce recycled medium.
2. Studying reactivation of idle medium machine at Fernandina Beach; machine would produce both recycled linerboard and medium.

It is still uncertain how the new Free Trade Act between the U.S. and Canada will affect imports and exports of containerboard and corrugated containers. In 1988, the U.S. exported only 23,000 short tons of corrugated containers to Canada.

The move toward a more open, internationally competitive marketplace will be painful for many Canadian producers. Since 1977, three containerboard mills have closed—two export-oriented kraft linerboard mills (Labrador Linerboard and MacMillan Bloedel) and a recycled linerboard mill. In total, these closures removed about 500,000 tpy of linerboard capacity from the market, although production still showed some growth. During the 1977-88 period, production of linerboard in Canada increased from 917,000 tons to nearly 1.4 million tons. At the same time, corrugating medium grew at a faster rate, rising from 341,000 tons to 781,000 tons, according to the Canadian Pulp & Paper Assn.

The Canadian linerboard industry is far more dependent on secondary fiber. Recycled linerboard accounts for about 25% of total linerboard capacity, compared with about 3% in the U.S. However, recycled medium in Canada accounts for about 19% of total production—slightly lower than in the U.S.

The corrugated container industry in Canada is almost totally integrated, with independents having well under 10% of the corrugated market (vs roughly 20% in the U.S.). Two integrated corrugated companies, Domtar Inc. and MacMillan-Bathurst Inc., account for more than half of the Canadian industry's box production. MacMillan-Bathurst is a 50-50 joint venture of MacMillan-Bloedel Ltd. and Stone-Consolidated Inc. Canadian Pacific Forest Products Ltd., formerly CIP Inc., ranks third with about an 11% share of the market. In 1988, Canadian corrugated box capacity totaled 31.5 billion ft^2.

CANADIAN CONTAINERBOARD PRODUCTION

(000 metric tons)

Year	Total containerboard	Linerboard*	Corrugating medium*
1988	1,977	1,267	710
1987	1,955	1,255	701
1986	1,847	1,199	648
1985	1,677	1,126	551
1984	1,695	1,087	608
1983	1,575	1,021	554
1982	1,364	891	473
1981	1,646	1,088	558
1980	1,671	1,175	496
1979	1,544	1,078	466
1978	1,520	1,023	497
1977	1,434	1,037	397
1976	1,315	949	366
1975	1,031	726	305
1974	1,494	1,031	463
1973	1,413	975	438
1972	1,240	855	385
1971	1,033	686	347
1970	1,041	710	331

* = Includes some recycled paperboard.

Source: Canadian Pulp & Paper Assn.

More than 25% of both linerboard and medium production is shipped outside of Canada. (Eurocan Pulp & Paper Co. is the largest liner exporter, and Stone-Consolidated and Papier Cascades Inc. are the biggest medium exporters.) While imports of linerboard are relatively small, imports of finished boxes have grown significantly. During 1982, a large part of the eastern Canadian corrugated industry was shut down by labor problems, and several U.S. box plants located near the border started shipping into Canada.

Canadian containerboard prices tend to follow those in the larger U.S. market, although they are at somewhat higher levels even after duty. Canadian producers last raised list prices on Apr. 1, 1988. Kraft linerboard (42 lb) went up \$35/metric ton to \$675, and semichemical medium (26 lb)

U.S. PRICES FOR CORRUGATING MEDIUM

(semichemical, 26-lb, eastern U.S.)

Year	\$/short ton	\$/1,000 ft^2
1989		
2Q	\$380/390*	\$4.94/5.07
1Q	380/390*	4.94/5.07
1988		
4Q	390/400*	5.07/5.20
3Q	390/400*	5.07/5.20
2Q	400*	5.20
1Q	360/370*	4.68/4.81
1987		
4Q	350/360*	4.55/4.68
3Q	330/340*	4.29/4.42
2Q	320/330*	4.16/4.29
1Q	320/330*	4.16/4.29
1986		
4Q	290/300*	3.77/3.90
3Q	290/300*	3.77/3.90
2Q	250/260*	3.38/3.51
1Q	240*	3.12
Year-end		
1985	240	3.12
1984	310	4.03
1983	280	3.64
1982	240*	3.12
1981	260*	3.38
1980	260	3.38
1979	240	3.12
1978	210	2.73
1977	180*	2.34
1976	200*	2.60
1975	190	2.47
1974	190	2.47
1973	140	1.82
1972	123	1.60
1971	120	1.56
1970	120	1.56

* = Indicates some discounting.

Source: *Pulp & Paper Week.*

rose $30/ton to $630. Reflecting the increase in raw material costs, Canadian corrugated box manufacturers raised prices by 5% to 6%.

Some industry experts doubt if another kraft linerboard mill will ever be built in Canada, although incremental expansion is taking place. The 1988 CPPA capacity survey showed kraft linerboard capacity increasing only 4% to 978,000 metric tons between 1987 and 1990. Recycled linerboard capacity will rise about 15% to 378,000 tons by 1990. This does not include Eurocan's rebuild of a machine at its Kitimat, B.C., mill, which will add 105,000 tpy of capacity. (Pulping will be expanded through installation of a chemi-mechanical pulping system—a new type of pulp for manufacturing kraft linerboard.)

Semichemical medium capacity is expected to show the most growth, rising from 532,000 tons in 1986 to 618,000 tons by 1990. This reflects mainly the installation of a new 150,000-metric-tpy machine at Stone-Consolidated's Matane, N.B., mill in late 1988. (The new machine replaced two older machines.) Recycled medium capacity is expected to decline slightly from 143,000 tons in 1987 to 138,000 tons in 1990.

ESTIMATED CONTAINERBOARD CAPACITY OF MAJOR CANADIAN PRODUCERS

(000 metric tpy)

	Linerboard	Corrugating medium	Total containerboard
Domtar	270**	145**	415
Stone-Consolidated	200	160[1]	360
CIP	225	85	310
Eurocan Pulp & Paper	235[2]	—	235
Paperboard Industries[3]	85*	50*	135
Cascades	—	115**	115
Atlantic Packaging	60*	40*	100
Irving (Lake Utopia)	—	90	90
Kruger	90*	—	90
MacMillan Bloedel	—	70	70
Crown Forest	35	25	60

* = Recycled containerboard.
** = Includes some recycled containerboard capacity.

[1] New 150,000-tpy machine installed at Bathurst, N.B., mill replaces two older machines for 45,000-tpy net increase in 1989.

[2] Rebuild will increase Kitimat, B.C., mill's capacity 105,000 tpy in 1989.

[3] Includes Belkin Packaging acquired in 1987.

Paperboard:

COATED AND UNCOATED KRAFT

Unbleached kraft paperboard other than linerboard is produced for three major packaging markets: beverage carriers, folding cartons, and multi-pack packaging for products traditionally packaged in corrugated containers. The remainder is used for tube, can and drum stock and other industrial converting applications. These miscellaneous uses are discussed at greater length in the chapter on converted products.

Unbleached kraft board is produced from 100% unbleached sulfate pulp.

Coated and uncoated kraft boxboard is unique because it offers a package with much higher strength than equivalent-weight bleached and recycled boxboard grades. In many cases, the strength of kraft boxboard allows dual-packaging capabilities as both a shipping container and as a folding carton that can be displayed. In addition, coated kraft boxboard is well suited for high-quality printing and foil and film laminating. Because of these properties, kraft board has had a major impact in the folding carton market.

Kraft boxboard and converting grades comprise only 7% of the total unbleached kraft paperboard market, but they account for approximately 17% of the domestic boxboard market (about one million short tons). The boxboard grades are also known as clay-coated linerboard, coated unbleached kraft, coated natural kraft, and the trademark solid unbleached sulfate (SUS).

The principal market for kraft boxboard is beverage-carrier stock—mainly for 6-packs of bottled beer, soft drinks, wine coolers, and mineral water, and also for larger 24-packs of beer in cans. The carrier market consumes nearly 70% of total kraft boxboard tonnage. Carrier stock used in refrigerated applications is made with wet-strength additives in either the kraft furnish or the coating or both. Typically, carrier stock has a basis weight of about 84 lb/1,000 ft^2 and a caliper thickness of 20 pt.

More recently, such clay-coated board has made a significant breakthrough in traditional folding carton markets. Kraft boxboard competes with recycled clay-coated newsback (CCN) and solid bleached sulfate board (SBS). Kraft boxboard provides better stiffness, tear resistance, and moisture resistance than SBS, and it has better printing and strength qualities than CCN. Kraft boxboard is often used in larger-size packages for detergents and other nonfood items, and as institutional packaging for wholesale distribution. Kraft boxboard is also used as preprinted linerboard

UNBLEACHED KRAFT PAPERBOARD CAPACITY FOR FOLDING CARTONS AND OTHER USES

(000 short tons)

Year	Folding cartons[1]	Other uses[2]
1991e	1,322	491
1990e	1,153	490
1989e	1,104	487
1988e	1,078	483
1987	1,000	473
1986	946	501
1985	905	500
1984	792	477
1983	800	493
1982	860	509
1981	804	540
1980	852	529
1979	827	520
1978	650	540
1977	645	561
1976	595	525

e = Estimate.
1. Includes carrier board.
2. Includes tube, can, and drum stock.

Source: American Paper Institute.

for small corrugated containers that are used to package consumer products. Such boxes are used not only to ship the product but also to serve as point-of-purchase displays.

Manville Forest Products Corp. and Mead Corp. together produce nearly all of the U.S. supply of coated and uncoated kraft board. Manville has production capacity of about 600,000 tpy of coated SUS kraft board on three machines at West Monroe, La. Two of the Manville machines underwent major rebuilds in the past two years to improve the multi-ply forming sections. The rebuilds were designed to improve product quality and to enhance Manville's position as the leading U.S. manufacturer of coated kraft board, which it markets as PearlKote folding carton board and AquaKote beverage carrierboard.

Mead's capacity for grades it refers to as coated natural kraft (CNK) is approximately 430,000 tpy at the company's Phenix City, Ala., mill, referred to as the Mahrt mill. Its products include Carton Kote, Carrier Kote, and Carrier Kote II. Mead acquired 100% ownership of the former Georgia Kraft Co. mill in early 1988, when it dissolved its joint venture with Temple-Inland Inc. Soon after this transaction, Mead broke ground for a $550-million expansion to install a new 350,000-tpy CNK paperboard mill adjacent to the existing mill site.

Westvaco Corp. is the third player in this market, although its Kraftpak unbleached folding carton board is an uncoated grade. Westvaco has an estimated 70,000 tpy of low-density Kraftpak board capacity at its North Charleston, S.C., kraft mill. Westvaco is a major supplier of uncoated laminating stock to Adolph Coors Co., which uses the uncoated board for the substrate in its polyester and foil laminated beer carriers. Westvaco's uncoated board is also approved by the Food & Drug Administration for food packaging, so its food-grade boards are used for packaging a variety of dry and frozen foods, and for bulk packaging in fast-food and institutional markets.

In 1988, Manville, Mead, and Westvaco combined had an estimated total unbleached kraft boxboard capacity of 1.1 million tons. Of this total, exports account for about 80,000 tons, and the market is growing rapidly. Projected capacity for 1991-92 is about 1.5 million tpy.

In Europe, coated kraft boxboard competes with similar grades produced in Sweden and Finland (the Billerud AB and Papyrus Kopparfors AB divisions of Stora, ASSI [AB Statens Skogsindustrier], and Korsnäs-Marma AB).

Unbleached kraft board benefited in 1988 from higher demand for nondurable end-use packaging, the most positive influence being a rise in packaging demand by the food and beverage sector. This accounted for about 55% of the value and 62% of the tonnage of folding cartons (including beverage carriers) that were shipped in 1988. Other improved end-use markets included sporting goods and hardware, tobacco, candy, and textiles. Meanwhile, demand decreased for paperboard packaging for soap, cosmetics, and medicinal products (including disposable diapers), according to the Paperboard Packaging Council (PPC).

UNBLEACHED KRAFT PAPERBOARD PRODUCTION BY GRADE, 1968-88

(000 short tons)

Year	Containerboard[1]	Boxboard[2]	Tube/can	Other	Exports	Total
1988	15,601	924	155	165	2,296	19,140
1987	15,380	865	161	190	2,303	18,898
1986	14,174	889	164	217	2,237	17,680
1985	13,353	822	164	198	1,830	16,367
1984	13,950	752	192	205	2,086	17,185
1983	12,720	710	204	207	2,281	16,122
1982	11,563	691	193	157	1,931	14,535
1981	12,654	672	219	171	1,887	15,603
1980	11,852	680	226	157	2,380	15,295
1979	12,306	598	267	234	1,645	15,150
1978	11,780	618	251	258	1,466	14,373
1977	11,283	588	228	262	1,290	13,651
1976	11,024	577	217	266	1,247	13,331
1975	9,586	463	176	260	1,058	11,543
1974	10,754	470	231	295	1,583	13,333
1973	10,951	455	226	333	1,597	13,562
1972	10,470	389	223	298	1,887	13,269
1971	9,155	339	194	276	1,834	11,800
1970	9,043	343	175	295	1,683	11,541
1969	9,242	287	187	417	1,683	11,816
1968	8,535	261	175	409	1,381	10,761

1. Containerboard figure is mostly linerboard from 1968-78, and is entirely linerboard after 1978.
2. Boxboard figure is folding carton stock and carrier board.

Source: American Paper Institute.

About 55% of the folding carton industry's 1988 consumption of boxboard was supplied by bleached and unbleached kraft grades, up from 53% in 1985. SBS is the most widely used woodpulp-based boxboard (estimated at about 38% of total industry consumption). Consumption of SBS remained flat in 1988 because virtually no new capacity was available. Demand for unbleached kraft grew at the rate of 8.8%/year during the 1960s and 4.6%/year during the 1970s—relatively good compared with the overall boxboard business, and outperforming both SBS and clay-coated recycled grades.

The use of clay-coated unbleached kraft board in folding cartons and carriers grew primarily because it offers considerable savings over SBS and because it is stronger than recycled board. Other industry statistics indicate that SBS usage in boxboard production increased an average of 4.1%/year during 1983-88. Unbleached kraft boxboard usage increased about 7.5%/year during the same period. Recycled boxboard usage increased an average of 3.0%/year.

In recent years, the folding carton market has been most promising for coated unbleached kraft board producers; future growth is limited only by available capacity. Demand for beverage carriers wavered in the early 1980s as beer consumption eased and as more beverages were bottled in two-liter plastic containers. But this market is rebounding, boosted by a heightened interest in better packaging graphics and by growth in new products such as wine coolers.

Bruce Kirk of Goldman Sachs & Co. estimated that clay-coated kraft board for folding cartons and similar retail merchandise packaging has grown consistently in recent years, with minimal cyclicity. Industry production has risen 100% since 1975 to approximately 925,000 tons in 1988.

Clay-coated unbleached kraft board, in terms of price and quality, is positioned between clay-coated recycled board and SBS used in milk cartons, cup/plate/food service items, and folding cartons. Generally, coated unbleached kraft board is priced slightly higher than the recycled equivalent and somewhat lower than the SBS equivalent. In 1989, the prevailing price of 20-pt clay-coated kraft folding carton board was about $580/ton, and the price of beverage carrierboard grades was about $625/ton.

During most of 1989, SBS prices were about $780/ton for 15-pt folding carton grades, and recycled 20-pt CCN boxboard prices were about $480/ton.

Compared with SBS, coated kraft has higher values for tear, mullen or puncture, machine-direction stiffness, and machine-direction block compression. This translates into a 1-pt caliper drop against SBS in lower calipers and a 2-pt caliper reduction in the higher calipers, resulting in a 3% to 4% savings on top of 12% to 15% savings from lower prices. According to Manville, it all adds up to a 15% to 19% savings over SBS.

Manville claims it is able to produce SUS at a lower cost than SBS because the production process requires less in chemicals and labor. SUS is superior in strength because it is not bleached, a process that weakens fibers.

In early 1988, Manville announced it would stop making TuffKote and would produce only one premium clay-coated grade called Pearl-Kote. Pearl-Kote has a bright blue appearance while SBS has a cream-white finish.

Manville makes SUS grades at its West Monroe, La., mill on Nos. 2, 6, and 7 paper machines. In recent years, major upgrades have improved quality and increased capacity at the mill, and the company is considering the rebuild of an idle No. 4 machine at the mill or the installation of a new machine with capacity in the range of 800 to 1,000 tpd.

In mid-1985, Manville completed a rebuild of No. 7 paper machine, which makes PearlKote—its "third generation of solid unbleached sulfate." This project reduced board plies to three from four, and it raised capacity to 575 tpd from 540 tpd. Machine capacity is expected to increase to about 800 tpd by 1990. Arcu-Formas on the machine were removed and replaced with a third fourdrinier. No. 7 has a maximum speed of 1,500 fpm with a normal trim of 232 in. It has the largest Yankee dryer in the world and coats the board in three stages, which gives it the bright blue finish.

No. 7's output is converted to food cartons (for frozen pizzas, ice cream, candy, etc.) and boxes for various consumer products and hardware items (e.g., diapers and automobile shock absorbers). It is coated one side (the printing side) and brown (unbleached) on the inside. Calipers range from 14 pt to 32 pt, and basis weights vary between 56 lb and 116 lb/1,000 ft^2. Some of the board is polyethylene-extruded on one or both sides by converters for wet or frozen end-use applications. It is marketed throughout the U.S.

No. 2 machine produces 235 tpd of lightweight (16- to 20-pt caliper) clay-coated board for both the beverage carrier and the folding carton markets, as well as a clay-coated preprinted linerboard. No. 2 machine, which dates from the 1930s, is expected to be retired in the mid-1990s.

No. 6 machine produces mainly Aqua-Kote wet-strength beverage carrier board. It was rebuilt in 1987, and is slowly reaching its annual rated capacity of 900 tpd. The other two machines, Nos. 1 and 5, make semichemical corrugating medium and lightweight kraft paper, respectively, for grocery bags and sacks.

Mead, too, is moving ahead with improvements and expansions. The company makes CNK on a 262-in.-wide fourdrinier at the Mahrt, Ala., mill. Until early 1987, the company also produced an additional 100,000 tpy at a nonintegrated coating facility in Atlanta, Ga., using board from Georgia Kraft or purchasing it from outside sources. That operation was shut down due to quality problems.

Mead's 1988 production capacity was 430,000 tons, or 39% of industry output. It converts 260,000 tpy, or about 60% of output at its own domestic beverage carrier and folding carton facilities. The balance of output—170,000 tons, or 40%—is sold on the domestic market to other converters or to Mead's offshore affiliate producers.

Mead's paperboard packaging business underwent significant consolidation and restructuring in 1987. It shed its linerboard and recycled paperboard operations, as well as six of its fourteen corrugated box plants, but it retained the Stevenson, Ala., corrugating medium mill. These divestitures were designed to focus corporate assets on value-added specialty products with higher and less cyclical profit margins, with major emphasis on CNK.

In its reorganization plan announced in March 1987, Mead intended to assume complete ownership of the Mahrt mill and to build a new 350,000-tpy CNK board machine there. With startup expected sometime in 1991, Mead's new mill is the major cause for an almost 30% jump in folding kraft boxboard capacity between 1989 and 1990. Mead plans to market the new machine's output through increased domestic conversion at its own plants, offshore sales to supply its offshore affiliates, and new opportunities in Japan resulting from a marketing agreement with Seibu Saison Group, Japan's largest consumer goods marketer. The new Mahrt mill will likely produce some linerboard at startup, if the machine's CNK output is not sold out.

Paperboard:

BLEACHED

Solid bleached sulfate (SBS) paperboard is used primarily for folding carton and milk carton packaging, and it is produced from a furnish containing at least 80% virgin bleached woodpulp. SBS is also used in the manufacture of disposable cups, plates, and food containers, as well as in bleached linerboard. It is sometimes substituted for bleached printing bristols, which are also produced by some SBS mills. (See chapter on bristols.)

Bleached board is produced in calipers ranging from 10 to 28 pt and in basis weights ranging from 40 to 100 lb/1,000 ft^2. Sheet density is the basis weight divided by the caliper. Density starts at about 10.5 lb/pt (lb/pt of caliper on 1,000-ft^2 basis) or less for low-density board, and it goes up to 16.0 lb/pt or more for high-density board. Medium-density board is in the range of 12.0 to 14.0 lb/pt.

U.S. STATISTICS FOR BLEACHED BOARD

	1989e	1988	1987	1986
Production[1], 000 tons	4,576	4,511	4,406	4,207
Capacity, 000 tons	4,735	4,715	4,679	4,576
Utilization rate, %	96.6	95.7	94.2	91.9
Exports, 000 tons	663	628	619	569
Imports, 000 tons	20	8	7	5
Apparent U.S. consumption				
000 tons	3,933	3,891	3,794	3,643
lb/capita	31.7	31.7	31.2	30.2
000 tons/$ billion real GNP (1982)	0.99	1.00	0.99	0.98

e = Estimate.
1. All tons are short tons.

Sources: American Paper Institute; *Pulp & Paper* estimates.

Additives are often mixed with SBS stock furnish to give the sheet certain characteristics, and coatings are added to smooth and seal the sheet. In folding carton board, for example, the sheet is typically coated with a 4-lb/1,000-ft^2 coat weight—typically a kaolin clay coating using S-B latex as binder. Acrylic binders are also commonly used. In liquid packaging furnish, synthetic waxes and polyethylene (PE) resin coatings are added to improve sheet holdout (liquid resistance) properties.

Nearly all bleached board used in folding carton stock is clay coated, and nearly all board used in frozen and liquid food packaging is coated with PE resins. Coating formulas vary according to the desired surface requirements and degree of holdout. On-machine blade coaters are typically used with most machines, but milk carton stock is usually extrusion-coated off the machine at the paper mill.

Gloss calenders are used with machines to improve the finish of high-gloss board. These high-gloss finishes are called cast coatings—a reference to the process in which coated board is pressed against a finished casting surface while the coating is still in a highly plastic state.

A blend of softwoods and hardwoods in about equal proportions is used to make SBS board. The mix is varied according to desired strength, density, and printability. Softwood content is higher for liquid packaging, for example, because of superior tear and tensile strength properties.

Bleached board is generally made on a conventional fourdrinier paper machine, a flat-forming suction type, with a secondary headbox commonly included to improve sheet formation and smoothness. Limited use is made of multi-fourdrinier paper machines in North America, but several liquid packaging producers have recently converted their machines to produce a multi-ply board.

A multi-fourdrinier machine combines a series of separate fourdrinier sections and headboxes on a single machine to produce a multi-ply board that has superior stiffness and less weight than a single-ply board. Also, a multi-ply board typically has a high groundwood content in the middle ply.

The top and bottom layers are made from hardwood and softwood bleached kraft (or sulfite) pulp, and the middle ply is made from chemi-thermomechanical pulp (CTMP) or thermomechanical pulp (TMP). The cost is generally lower due to the use of lower-cost groundwood pulp.

Multi-fourdrinier machines have been successfully operated for several years in Europe, but they have only recently been accepted in North America. Continental Forest Industries Inc. installed a new multi-ply machine at its Augusta, Ga., mill in 1978, but the mill experienced severe operating problems with the Voith equipment. The mill was subsequently sold in 1985 to Federal Paper Board Co., which converted No. 3 machine to production of 100% single-ply bleached kraft SBS paperboard.

In 1988, Cascades Inc. converted an older cylinder board machine at its Jonquière, Que., mill to a three-fourdrinier machine using Ahlstrom/Valmet technology. The Cascades machine uses TMP and bleached kraft pulp to produce a double-white, three-ply board that could replace SBS in food packaging applications. In 1990, Tembec Inc. is scheduled to bring online a new Tampella three-fourdrinier machine at its Temiscaming, Que., mill. Tembec's new machine will produce 110,000 metric tpy of low-density bleached paperboard using a combination of CTMP and sulfite pulp. In the U.S., Weyerhaeuser Co., Potlatch Corp., and International Paper Co. have upgraded their existing liquid packaging board machines by installing new twin-wire systems and dual-channel headboxes to produce a low-density multi-ply board with improved sheet formation, smoothness, stiffness, and printing characteristics.

INDUSTRY STRUCTURE

Bleached paperboard is manufactured by 13 major suppliers in the U.S. and by three in Canada. U.S. capacity is fairly concentrated, with the top five producers accounting for over 60%. International Paper, Federal Paper Board, and Westvaco Corp. are the three largest producers. Both Federal and Westvaco have committed to installing new bleached board machines by 1992, and IP is increasing capacity of existing machines.

As previously mentioned, Federal significantly expanded its market share in 1985 with the acquisition of Continental Forest's Augusta, Ga., mill. Jefferson Smurfit Corp. entered the bleached board segment in 1986 when it acquired 50% ownership of Container Corp. of America's Brewton, Ala., mill. Georgia-Pacific Corp. doubled its SBS production capacity in 1988 when it purchased Brunswick Pulp & Paper Co., a joint venture of Mead Corp. and Scott Paper Co.

Some bleached board machines are also capable of producing lightweight bleached bristols or bleached pulp. This swing capacity allows producers to adjust production to market conditions and take advantage of more profitable

U.S. BLEACHED BOARD PRODUCTION BY END USES[1]

(000 short tons)

Year	Total	Cartons		Heavyweight cup stock	Plate, dish, and tray	Linerboard	Other food packaging	Miscellaneous packaging[2]
		Folding	Milk					
1988	4,862	2,062	1,111	566	267	524	256	75
1987	4,636	2,023	1,116	486	270	404	281	55
1986	4,535	2,076	1,226	442	276	121	348	45
1985	4,282	1,955	1,227	422	245	(D)	404	29
1984	4,104	1,895	1,092	455	225	118	288	31
1983	3,988	1,901	1,060	440	252	113	191	31
1982	3,757	1,743	1,052	418	227	101	184	32
1981	4,070	1,981	1,085	427	245	120	223	49
1980	4,026	2,063	1,015	401	263	—	—	40
1979	3,883	1,999	1,090	341	232	102e	—	119
1978	4,002	1,934	1,048	400	277	159e	—	184
1977	3,882	1,822	1,040	419	296	92	53	160
1976	3,876	1,880	1,050	370	267	103	23	183
1975	3,420	1,540	1,052	329	274	88	—	137
1974	3,827	1,706	1,055	442	322	104	—	198
1972	3,741	1,637	1,006	389	350	139	—	220
1970	3,404	1,395	971	369	317	133	—	219

(D) = Data withheld to prevent disclosure of figures for individual companies.
e = Estimate.
1. Production for both foreign and domestic uses.
2. Includes other food packaging when not included in separate category 1970-79.

Source: Bureau of the Census.

markets. However, many mills prefer to remain consistent with their grade mix unless markets change substantially. Also, very little swing capacity is available when SBS supply is tight.

In the early 1980s, as much as 200,000 to 300,000 tons of bleached pulp was annually produced on bleached board machines. Most of this pulp was not papermaking chemical-grade bleached pulp; rather, it was highly absorbent fluff pulp used in the manufacture of disposable diapers and other sanitary products. This fluff pulp was shipped in rolls rather than baled.

Requirements for fluff pulp have become more specialized, and overall growth in demand has slowed due to the introduction of superabsorbents. Furthermore, two leading producers of fluff pulp that also produce bleached board—Weyerhaeuser and International Paper—have shifted production from swing machines to dedicated facilities.

American Paper Institute data show that pulp produced on SBS machines totaled 97,600 tons in 1984, 54,000 tons in 1985, 27,915 tons in 1986, 41,473 tons in 1987, and 15,005 tons in 1988. The annual trend in early 1989 was only 5,000 tons.

In addition to reducing swing capacity, producers have also lowered the basis weight and density of SBS boards. A lower-density board with stiffness and quality comparable to higher-density board of several years ago is now possible. The result is more units of product per ton of board. Upgrading the printing quality of folding carton board is another trend in the U.S. market. Examples are Westvaco's premium-grade Printkote Hi-Gloss stock and IP's Val-U-Coat board.

From 1970 to 1979, bleached board capacity grew at a 1.7% annual rate, but it declined 1.9% during 1979-84, according to API figures. In 1985, however, capacity began to creep up again, rising from 4.37 million short tons to 4.67 million tons in 1987 and 4.72 million tons in 1988. Capacity is expected to grow at about a 2.1% annual rate, reaching 4.98 million tons in 1991.

The primary cause for the jump in capacity between 1985 and 1986 was the startup of a new 175,000-tpy SBS machine at Westvaco's Covington, Va., mill. However, some of this capacity was offset by the shutdown of a smaller, older machine at the same facility. API initially projected more substantial capacity gains in the late 1980s, but Federal Paper Board stretched out expansion plans for its Augusta, Ga., mill. It will install a new lightweight coated SBS board machine there during 1992, adding an estimated 225,000 tons of annual capacity.

The majority of the 27 bleached paperboard machines in the U.S. are located in the Southeast. Most range in capacity size from 150,000 to 250,000 annual tons, and more than half were installed or rebuilt after 1970. Companies have also improved the efficiency of their mills in recent years through new labor rules and capital spending projects. Several producers such as Federal Paper Board, Potlatch, International Paper, and Temple-Inland Inc. have also undertaken major energy conservation projects at their mills.

From 1976 to 1985, bleached board production rose at about a 1.5% annual rate. The weak performance was due to lower domestic demand for milk cartons in favor of plastic containers, competition from plastics in the food-service segment, and slower export growth. Another factor that

U.S. BLEACHED BOARD PRODUCTION

Year-end	Tonnage (000 short tons)	Change (%)
1988	4,511	7.2%
1987	4,406	4.7
1986	4,207	7.6
1985	3,911	-2.5
1984	4,011	3.0
1983	3,895	6.9
1982	3,644	-6.2
1981	3,886	1.3
1980	3,836	-3.4
1979	3,973	0.5
1978	3,955	6.8
1977	3,703	-3.1
1976	3,820	14.9
1975	3,324	-11.4
1974	3,752	-2.3
1973	3,842	4.8
1972	3,667	9.0
1971	3,363	1.1
1970	3,327	-6.5
1969	3,560	—

Source: American Paper Institute.

CAPACITY FOR BLEACHED BOARDS OF MAJOR U.S. COMPANIES

	Company	Annual capacity (000 short tons)	Capacity share (%)
1	International Paper	935	19.7%
2	Federal Paper Board	631	13.3
3	Westvaco	600	12.7
4	Potlatch	554	11.7
5	Georgia-Pacific[1]	360	7.6
6	Temple-Eastex	357	7.5
7	Champion International	247	5.2
8	James River	235	4.9
9	Gulf States Paper	230	4.8
10	Weyerhaeuser	210	4.4
11	Gilman Paper	200	
12	Jefferson Smurfit	167	
13	Union Camp	140	

Total U.S. capacity (1989): 4.735 million short tons[2]
Capacity share of top five companies: 65.0%
Capacity share of top ten companies: 91.8%

[1] Acquired Brunswick Pulp & Paper Co. in 1988.

[2] Company figures total exceeds API industry capacity because of swing capacity for bleached bristols and pulp.

held back SBS tonnage growth was a trend toward reduced basis weights, especially for folding cartons.

Since 1986, demand for SBS has been very good. Total U.S. production of bleached board in 1986 was up 8.7% to 4.29 million tons after a drop of 2.5% to 3.95 million tons in 1985. In 1987, production again rose, moving up 3.2% to 4.4 million tons, and in 1988 it hit a record 4.48 million tons. Operating rates rose to 94.5% in 1987 and 95.1% in 1988. At the beginning of 1989, most mills were sold out and turning away new business.

During the past decade, U.S. bleached board exports grew at about a 6% to 7% annual rate and accounted for about 12% to 14% of total U.S. production. From a peak of 557,000 tons in 1981, however, SBS production for export declined steadily to a low of 466,000 tons in 1985. The decline reflected the impact of the strong dollar and increased competition in Europe from Scandinavian producers. But as the dollar weakened, exports jumped 22% to 569,000 tons in 1986, and they increased further to 619,000 tons in 1987. In 1988, export growth was limited due to domestic supply shortages, particularly for milk carton stock, which accounts for about 75% of SBS exports. Export volume in 1988 was 628,000 tons.

The price of SBS, which fluctuates with market conditions, has strengthened each year since 1986. Prices deteriorated between 1981 and 1985, except for a brief recovery in 1984 when some producers got as much as $645 to $665/short ton for 15-pt folding carton stock. In 1981, the list price was a firm $625, which was eroded by discounting in 1985 to between $500 and $590, severely squeezing profitability.

Prices strengthened when market demand recovered in 1986. Producers raised prices an average of two times per year during the 1986-89 period. End-of-year prices for 15-pt coated folding carton stock were approximately $580/ton in 1986, $635/ton in 1987, $730/ton in 1988, and $830/ton in 1989.

MARKETS

Folding cartons are the largest end use for SBS board, accounting for approximately 49% of production in 1988. Milk carton stock made up about 24% of the market; cup and plate, 18%; linerboard and other packaging and nonpackaging stock (including printing boards, aseptic packaging, and ovenable paperboard), 9%.

The U.S. folding carton market is mature, but demand has grown about 3% annually since 1986, and SBS has maintained about a 38% share of the domestic market. API statistics for 1988 show total domestic folding boxboard production at 5.29 million tons, of which 2.35 million tons were recycled boxboard (44.4%), 2.02 million tons were SBS (38.2%), and 924,000 tons were solid unbleached sulfate (17.4%).

The fastest growth in the folding carton market has been achieved by clay-coated unbleached kraft grades, which have nearly doubled their market share since 1972. Coated unbleached kraft grades not only offer greater strength than recycled boxboard and cost less than SBS, they will probably continue to increase their share of the market. (See chapter on coated and uncoated kraft board.) Prices for coated unbleached kraft folding carton grades fall between those for SBS and recycled grades, averaging $540 to $580/ton in 1989.

In addition to the growing popularity of coated kraft grades, another competitive factor for SBS is the widening price gap with clay-coated recycled boxboard. The price differential between SBS and clay-coated recycled newsback (CCN) folding carton board reached an unprecedented level

U.S. CAPACITY FOR BLEACHED BOARDS

(000 short tons)

Year	Linerboard	Folding	Milk carton and food service	Other	Total	Change (%)
1991e	186	2,422	2,201	176	4,985	3.5%
1990e	181	2,350	2,107	176	4,815	1.7
1989e	168	2,312	2,078	177	4,735	0.4
1988e	167	2,318	2,051	179	4,715	0.8
1987e	148	2,309	2,031	191	4,679	2.3
1986	135	2,341	1,926	175	4,576	4.7
1985	131	2,223	1,843	173	4,370	4.4
1984	119	2,095	1,771	200	4,185	2.1
1983	104	2,020	1,758	217	4,100	-3.0
1982	104	1,988	1,812	219	4,123	2.7
1981	108	1,904	1,774	229	4,015	-4.0
1980	116	1,954	1,865	246	4,180	-3.2
1979	133	2,080	1,916	189	4,318	2.9
1978	122	1,996	1,899	179	4,197	4.4
1977	97	1,930	1,824	170	4,020	0.6
1976	101	1,915	1,854	128	3,998	5.0
1975	95	1,751	1,859	102	3,807	-2.9
1974	108	1,851	1,848	113	3,920	-0.2
1973	141	1,749	1,899	139	3,928	3.7
1972	134	1,583	1,937	134	3,788	6.1
1971	143	1,455	1,842	128	3,569	2.8
1970	130	1,406	1,739	197	3,472	-2.4
1969	150	1,500	1,689	218	3,557	—

e = Estimate.

Sources: American Paper Institute, *Pulp & Paper* estimates.

of $350/ton in 1989. Prices for CCN averaged about $480/ton in early 1989, vs $780/ton for SBS. In the early 1980s, the price differential averaged between $150 and $200/ton. However, because of higher yield on an area basis due to lower density in bleached board, the extreme price differential between the two grades is somewhat reduced in the converting process.

SBS producers convert about 50% of their folding carton production. The largest integrated SBS folding carton producers are International Paper, James River Corp., and Westvaco. The largest suppliers of SBS to independent folding carton converters are Federal Paper Board, Temple-Eastex Inc., Potlatch, and Gilman Paper Co.

Folding carton profits have been poor for several years because prices for converted folding cartons have not kept pace with the rapid rise in SBS board prices. As a result, Champion International Corp., Temple-Eastex, and Potlatch have all divested their folding carton plants in recent years, while IP and Federal have closed money-losing folding carton plants.

Liquid packaging board. Demand for liquid packaging board fluctuated during the past two decades. Production rose in the early 1970s but declined over the next 15 years. Domestic milk carton production fell almost steadily from 941,000 short tons in 1970 to 591,000 tons in 1982. In 1983, however, production was up 2.7% to 607,000 tons, and it rose 6.3% in 1984 to 645,000 tons. In 1985 and 1986, production fell to 609,000 tons and 591,000 tons, respectively. In 1987, production rebounded again to 624,000 tons, and then slipped to 606,000 tons in 1988.

U.S. BLEACHED BOARD EXPORTS[1]

(short tons)

Year	API[2]	Census
1988	628,000	743,000
1987	619,000	648,000
1986	569,000	571,000
1985	466,000	518,000
1984	478,000	543,000
1983	514,000	558,000
1982	525,000	526,000
1981	557,000	584,000
1980	545,000	560,000
1979	466,000	490,000
1978	430,000	440,723
1977	389,000	374,823
1976	306,000	352,638
1975	—	284,203
1974	—	374,642
1973	—	265,169
1972	—	208,516
1971	—	183,257
1970	—	129,139
1969	—	131,946

1. Imports are minor.
2. American Paper Institute data represent production for export, not shipments.

In 1985-86, liquid packaging board accounted for about 15% of sales within the sanitary food container industry, compared with 20% in 1972. About 505,000 tons—or 17.5 billion units—were shipped in 1985-86, according to the Dept. of Commerce.

Most of paperboard's loss of market share in milk packaging is in gallon and half-gallon sizes in the Midwest and West. Since 1980, erosion in the gallon segment has eased, but further loss in the half-gallon segment is still a concern. Some forecasts expect plastic to capture as much as 50% of the market currently held by paperboard in the half-gallon segment.

According to the Dept. of Agriculture, paperboard's total share of fluid milk packaging shifted from 78% in 1971 to 33% in 1987. During that time, the share of plastic containers (made from high-density PE) went from 15% to 67%. Of the gallon containers sold for fluid milk packaging in 1987 (the last year for which statistics are available), 98.6% were plastic and 1.4% were paperboard. In the half-gallon sizes, 23.5% were plastic and 71.3% were paperboard. In the smaller sizes, paperboard still had approximately 97% to 99% of the market.

Besides competition from plastics, carton use is depressed because of modest growth in domestic milk consumption. In 1987, 54.416 billion lb of milk were consumed in the U.S. While consumption was up 0.6% from the previous year, this figure is only a 1.3% improvement over 1976. From 1972 to 1982, domestic milk consumption steadily declined, but it has since turned around largely because of a "baby boom" among young families.

Although carton use for milk packaging has declined, other types of liquid packaging are growing. This is especially true for juice and juice derivatives. The Paperboard Packaging Council (PPC) estimated that juice and juice-drink cartons comprised 25% of the market in 1988, compared with about 5% ten years earlier. More cartons are being used to package nondairy beverages as well as dry foods, pet foods, and various nonfood items, according to the U.S. Bureau of Industrial Economics.

For its part, PPC has fought further deterioration in the paperboard carton market with a campaign started in 1982 to publicize the nutritional advantages of milk packaged in paperboard instead of plastic. The promotion appears to be working. In 1983-84, domestic milk carton consumption was up for the first time since 1975. It slipped again in 1985 to the same level as in 1983, but this was attributed by some industry experts to a temporary halt in the PPC campaign when it was challenged by the plastics industry. The promotion was resumed in 1986 and ran through 1988.

Other promotions begun in recent years could also have increased milk carton sales. The paperboard gallon two-pack was introduced as an alternative to the plastic gallon jug. Another promotion, begun in 1985, features photographs and descriptions of missing children on side panels of milk cartons, an idea later extended to paper cups. However, this campaign was losing popularity by early 1987.

For all practical purposes, the domestic milk carton sector is 100% integrated. International Paper and Champion International are the largest producers of milk carton blanks, which are shipped flat to dairies. The other integrated producers are Potlatch and Westvaco. The fifth U.S. producer of milk carton stock is Weyerhaeuser, which sold its Vancouver, Wash., milk carton plant to a subsidiary of AB Tetra Pak in mid-1989. Weyerhaeuser will remain a paperboard supplier to the plant.

Export demand for milk carton packaging has shown strong growth, averaging about 5% annually in recent years. In 1988, an estimated 460,000 tons—or 40%—of total milk carton production was exported. International Paper, Potlatch, and Weyerhaeuser are the major U.S. exporters of milk carton stock. The two other major U.S. producers, Champion International and Westvaco, do not export any significant amount of milk carton stock. U.S. producers are very competitive with Scandinavian producers in worldwide liquid packaging markets.

Aseptic liquid packaging. This innovative packaging system has expanded rapidly in the U.S. since its introduction about five years ago. Estimates place the number of aseptic cartons sold in the U.S. at between 4.5 and 5.0 billion units in 1988. However, the volume of liquid packaging board used for such aseptic packaging in the U.S. is still small, and most requirements are imported from Scandinavian producers. The preference for imports reflects the fact that the largest aseptic packaging converter in the U.S. is a subsidiary of AB Tetra Pak, a $2-billion Swedish company with an estimated 90% share of the world market.

AB Tetra Pak has installed nearly 5,800 proprietary packaging machines in 102 countries, and it operates 26 packaging material factories, six machine assembly plants, and 47 marketing companies worldwide. In 1988, some 50 billion Tetra Pak cartons were produced, equal to about 135 million cartons/day.

Aseptic cartons use advanced coextrusion technology to produce a shelf-stable package requiring no refrigeration to retain product freshness and quality. The cartons combine specially treated paperboard with plastic film and aluminum foil or other combinations. It is not necessary to use solid bleached board in this configuration. In fact, most of the Tetra Pak cartons use a multi-ply sheet produced from unbleached stock.

The aseptic laminate is sterilized with a special hydrogen peroxide bath, high heat, steam, or other processes. After filling, the cartons require little or no refrigeration. They have greatly extended shelf life, and they are compact and convenient to carry and store. In short, the package is designed to save more than it costs to produce. Aseptic containers are used to package soft drinks, juices and juice concentrates, gelled foods, baby foods, sauces, pastes, gravies, and puddings. Attempts have been made to market aseptically packaged milk in the U.S., but dairies have difficulty breaking consumer perceptions that milk must be refrigerated to remain fresh.

Aseptic packaging was developed in Europe and approved by the U.S. Food and Drug Administration in 1982. Most aseptic packaging comes from its inventor, AB Tetra Pak. Its U.S. subsidiary based in Texas is Brik Pak Inc. Combibloc Inc., controlled by a Fed. Rep. Germany company, is the second-largest manufacturer, followed by a relative newcomer, International Paper.

In 1987, IP entered into a joint agreement with SIG Swiss Industrial Co. to market in North America the new SIG high-speed aseptic packaging system. Since then, IP has developed a special Barrier Pak multi-layer paperboard for use in aseptic packaging, and it produces this packaging

U.S. PRICES FOR BLEACHED KRAFT BOARD

($/short ton)

Year	15-pt, folding carton, C1S 80 bright (rolls)	Cup stock, uncoated
1989		
2Q	$780/790	n.a.
1Q	780/790	n.a.
1988		
4Q	720/740	$625
3Q	720/740	n.a.
2Q	665/700	n.a.
1Q	625/660	n.a.
1987		
4Q	625/660	574
3Q	600/645*	n.a.
2Q	590/645*	n.a.
1Q	570/625*	n.a.
1986		
4Q	570/625*	556
3Q	570/625*	n.a.
2Q	550/600*	n.a.
1Q	(500/590)	n.a.
1985		
4Q	(500/590)	507
3Q	(500/590)	n.a.
2Q	550/665*	n.a.
1Q	550/655*	n.a.
Year-end		
1984	590/665*	584
1983	590/625*	565
1982	590/625*	507
1981	625	584
1980	550	565
1979	490	570
1978	425/445	581
1977	405	482
1976	385	457/468
1975	360/365	406
1974	360	386
1973	300	364
1972	265	342

Note: Prices generally higher on the West Coast.
n.a. = Not available.
( ) = Indicates estimated transaction prices where most volume is moving significantly below list.
* = Discounting from list prices reported.

Source: *Pulp & Paper Week.*

at a new, state-of-the-art facility in Raleigh, N.C. This facility can produce a five-layer cold-fill or six-layer hot-fill coextruded sheet. IP now sells its aseptic board in over 20 countries. The bleached paperboard is supplied by the company's mills at Pine Bluff, Ark.; Texarkana, Texas; and Balstrop, La.

Forecasts of aseptic packaging growth in this country are very optimistic. In a 1986 report, for example, Business Communications Co. (BCC) projected an annual growth rate of 10% for the aseptic food and beverage market during the following ten years. Total production of aseptic food/beverage containers was expected to reach 12.2 billion units in 1995, or about 4% of the entire food/beverage packaging market. At the time of the report, aseptic containers totaled about 4.5 billion units annually, or 1.5% of the 313-billion-unit food/beverage market. Juices and juice products will remain the largest market segment through 1995, although other new products packaged aseptically will show higher real growth rates.

Aseptically packaged dairy products such as sour cream and individually packaged cream will gain wider acceptance over the next few years. But consumer preference for refrigerated milk will continue to thwart expansion of that product in aseptic packages, according to BCC. The BCC study noted that viscous and particulate products will be the most attractive new additions to the aseptic food/beverage line. The first real challenge to metal and glass packaging will occur during the late 1980s and early 1990s with the introduction of aseptic processing equipment and fillers that can preserve particle integrity, such as for soup.

Ovenable paperboard. The performance of ovenable paperboard, another innovative package system, has failed to match industry expectations, but it remains another leading-edge technology for the bleached paperboard industry. This type of paperboard, which can be used in both microwave and conventional ovens, has undergone many improvements in structure and design since its introduction in the 1970s. Ovenable paperboard is typically made by coating SBS with a polyethylene terephthalate resin and pressing or die cutting the SBS sheet into trays.

U.S. SANITARY FOOD CONTAINERS INDUSTRY: VALUE OF SHIPMENTS AND CONSUMPTION OF PAPER AND BOARD

	1982*		1987**	
	Paper and board consumed (000 short tons)	Value of products (million $)	Paper and board consumed (000 short tons)	Value of products (million $)
Total: (SIC Code 2654)	—[1]	$2,545.6	—[1]	$1,940.6
Milk and milk-type cartons[2]	569	550.0	526.5	557.5
Cups and liquid-tight containers	—	885.0	—	848.5
Liquid-tight containers[3]	32	64.0	24.2	61.3
Drinking cups[4]	451	821.0	459	786.6
Cups[5]	—	0.1	—	0.6
Other sanitary food containers[6]	—	356.0	—	457.9
Food serving products				
Stamped plates, dishes, spoons	227	259.0	202	273.2
Ovenable food trays	—	—	15	37.3
Other paperboard items	32	63.0	30	22.7
Other paper items[7]	—	—	—	112.4
Frozen foods and bakery[8]	196	229.0	297	360.0
Butter and ice cream packaging and food pails	155	170.0	209	258.2
Processed meats, margarine[9]	83	106.0	70	96.1
Others[10]	—	42.0	—	50.0

1. Data not collected or available.
2. Including juices, beverages, and other products.
3. Plus round nested food containers, including lids and tops.
4. Plus portion serving cups.
5. And liquid-tight containers not classified.
6. Includes food containers, boards, and trays.
7. Includes tablecloths and soda straws, except glass or plastic.
8. Including frozen bakery.
9. Plus lard and shortening.
10. For fresh meat, poultry, and produce for retail packaging.

* = Source: 1982 Census of Manufactures.
** = Source: 1987 Census of Manufactures.

While use of microwave ovens has grown dramatically, current size of the ovenable paperboard market in the U.S. may still be less than 30,000 tpy, according to some estimates. One reason for the modest growth of ovenable paperboard is the development of an all-plastic tray that has been widely accepted by the frozen-food industry. Nevertheless, demand for ovenable paperboard grew at about a 6% annual rate during the past several years, according to the Dept. of Commerce. The increasing popularity of oven-ready meals and single-portion servings should continue to provide growth for paperboard in this market. Westvaco's Ovenware package, which goes directly from freezer to microwave or oven, has been accepted by consumers and packaged-food companies alike.

As with liquid packaging, bleached board is facing heavy competition from plastics in the disposable food-service segment. While dollar sales of converted trays, plates, cups, and nested and liquid-tight containers have remained fairly stable, unit volume of such paper products has probably declined, according to the Dept. of Commerce. In an attempt to counter competition from plastics, the industry has concentrated on improving the strength, appearance, and design of its cups and other food-service products.

According to API statistics, production of bleached paperboard cups, plates, trays, and rounded nested food containers was relatively stable during the last decade. Production of paperboard used to manufacture these products totaled 791,800 tons in 1988, which is a 3.4% improvement from the year before.

Plastics has captured about 60% of the beverage cup market and an even higher share of the plate market, according to some industry estimates. Weak plastic resin prices in 1985-86 helped some integrated resin producers such as Mobil Corp. and Amoco Corp. gain market share, but the run-up in plastic resin prices that began in 1987 reduced their profits for these products. In general, plastic food-service products cost 25% to 30% less than their paper counterparts.

PE-coated paperboard has best held its market share in the larger-size cold-service cups, while plastic foam cups and trays have made their largest inroads in the hot-service area. Plastic has also made significant gains in nested and other liquid-tight containers. Thermoformed plastic containers, for example, have taken over much of the market for dairy products such as cottage cheese and yogurt.

Plastic food-service disposables have drawn the wrath of environmental activists because they are neither biodegradable nor widely recycled and because toxic byproducts are produced during their manufacture. Although the plastic industry has responded by changing the chemical composition of its products and by recycling more of its waste, many communities and state governments still want to ban the products. In the short term, this should increase demand for paperboard disposables.

Temple-Eastex is the largest producer of cup and plate stock, but it has no converting facilities and sells all of its mill production to independent converters. James River is the major integrated producer of both paper and plastic food-service products through its Marathon and Dixie lines. Federal Paper Board sold its plate converting operations to the Fonda Group in 1985, but Federal re-entered the business in 1989 when it purchased Imperial Cup Corp. Similarly, Scott Paper purchased Texstyrene Corp.'s disposable cup business in 1988 and Cross Paperware in 1989. Fort Howard Corp. was formerly the largest independent converter and marketer of disposable paper and plastic products through its Maryland Cup and Lily-Tulip operations, but these businesses were sold to Silgan Corp. in 1989.

OUTLOOK

Analysts expect the bleached board market to expand slightly in 1989, but industry capacity is severely constrained. Most mills were fully sold out and turning away new business throughout the year. According to one estimate, folding carton production will reach about 2.055 million tons in 1989, with milk carton increasing to 625,000 tons, cup stock rising to 490,000 tons, and plate stock increasing to 340,000 tons. Total SBS production will reach 4.5 million tons in 1989, according to one analyst. Another analyst projected a hike to 4.565 million tons in 1989.

The long-term forecast for folding carton stock remains optimistic because of increasing demand for packaging and increasing emphasis on printing and graphics. Food companies, for example, are using new packaging to introduce new products and to promote existing mature products. In addition, the increase in microwave oven sales has expanded the market for microwave foods, which are mostly sold in folding cartons. Greater emphasis on personal health has opened up new packaging opportunities in health foods and over-the-counter medicines. The explosion in consumer electronic products will also fuel demand for cartons.

Provided that consumers continue spending an increasing share of their income on packaged foods and disposable food-service products, the Dept. of Commerce expected the real value of sanitary food container shipments to climb about 2% in 1989—about the same rate of growth as in 1988. Sales of paperboard milk cartons were expected to increase slightly during 1989 at the expense of plastic containers—the result of expansion into new markets. Sales of aseptically packaged juices and other drinks were expected to continue expanding; however, aseptic milk shipments

FLUID MILK SALES BY PACKAGE SIZE AND TYPE*

Container size	Total sales (million lb)	Type of container (% of total sales)		
		Glass	Paper	Plastic
Gallon	2,112.9	<0.1%	1.4%	98.6%
Half-gallon	732.2	1.1	71.3	23.6
Quart	163.4	1.1	96.8	2.1
Pint	60.8	<0.1	97.5	2.5
Half-pint	334.2	<0.1	99.3	0.7

* = Sales for Nov. 1987 by handlers regulated in Federal Milk Order markets. Represents 75% of U.S. handlers.

Source: U.S. Dept. of Agriculture.

PERCENT OF FLUID MILK SALES* BY PACKAGE TYPE

Year	Glass	Paper	Plastic	Other
1987	<0.5%	33%	67%	<0.5%
1985	<0.5	35	65	<0.5
1983	<0.5	38	62	<0.5
1977	1.0	58	41	<0.5
1971	7.0	78	15	<0.5
1966	25.0	67	6	2.0
1963	32.0	63	n.a.	5.0

n.a. = Not available.
* = Represents total fluid milk, including whole, lowfat, and skim.

Source: U.S. Dept. of Agriculture.

should grow more slowly, constrained by hard-to-change consumer buying habits and tastes, according to the Dept. of Commerce.

For the 1987-91 period, the Dept. of Commerce's forecast calls for an average annual growth rate of about 2.2% for sanitary food container shipments, provided there is gradual improvement in retail food sales as well as continued growth in fast foods and convenience foods.

Aseptic and microwave containers will continue to be the packaging industry's growth leaders. New food-packaging mediums will appear, especially barrier plastics (coextruded, multilayer plastic containers that extend nonrefrigerated shelf life for a variety of food products such as juices and sauces) and retortable, flexible, food-filled plastic bags, which also extend nonrefrigerated shelf life and are especially geared to packaging solid foods.

Plastics will play an increasing role in the construction of the aseptic package, sometimes displacing paperboard and foil completely. Sales of ovenable paperboard trays will continue rising, but plastics will likely provide increasing competition in this packaging sector.

Export shipments of U.S. bleached board should continue growing faster than domestic demand. However, increased use of aseptic packaging in various parts of the world may favor Scandinavian producers, particularly in Europe. Most future growth for U.S. exports will be in Asia, which now accounts for about 70% of U.S. milk carton shipments.

CONVERTED BLEACHED BOARD PRICES

(BLS price index)

Year	Milk and milk-type containers[1]	Cups and liquid-tight containers[2]	Bleached packaging and industrial converting paperboard[3]
1988			
4Q	349.4	121.2	122.8
3Q	354.1	113.4	115.5
2Q	345.6	113.3	113.6
1Q	339.5	109.3	106.9
1987			
4Q	334.7	109.3	106.9
3Q	336.8	109.3	106.8
2Q	337.5	106.7	107.3
1Q	332.9	105.2	108.7
1986			
4Q	334.3	105.0	108.3
3Q	336.6	102.0	107.3
2Q	332.7	100.6	106.2
1Q	333.3	100.1	105.9
1985			
4Q	335.9	100.2	107.7
3Q	339.5	99.9	107.9
2Q	336.2	n.a.	108.2
1Q	329.1	n.a.	108.5
Year-end			
1984	314.0	231.0	109.3
1983	302.5	220.0	103.0
1982	275.8	220.0	—
1981	257.5	220.0	—
1980	220.8	197.1	—
1979	199.0	180.1	—
1978	185.0	[illegible]8.1	—
1977	180.7	140.2	—
1976	169.3	132.6	—
1975	157.7	126.7	—
1974	145.0	125.6	—
1973	109.3	106.4	—
1972	106.7	103.3	—
1971	102.0	103.3	—
1970	99.8	98.8	—

n.a. = Not available.

1. 1967 = 100 (per 1,000). Listed as "Milk Cartons, Gal." prior to July 1985.
2. June 1985 = 100; 1967 to June 1985 = 100 (per 1,000). Listed as "Paper cups, hot" prior to June 1985.
3. December 1982 = 100.

Sources: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Prices and Price Indexes.

SUMMARY OF SANITARY FOOD CONTAINER INDUSTRY STATISTICS (SIC Code 2654)

Year	Plants (total)	Employees	Value of shipments[1] (million $)	Capital expenditures (million $)
1987	92	16,900	$2,192	$97.3
1986	—	24,700	2,934	142.6
1985	—	23,400	3,014	112.5
1984	—	22,800	2,944	64.6
1983	—	23,600	2,912	78.5
1982	145	24,600	2,826	67.1
1981	—	28,300	2,842	70.7
1980	—	28,400	2,900	56.0
1979	—	29,800	3,196	65.7
1978	—	28,900	3,161	71.5
1977	193	28,700	3,258	52.4
1976	—	30,600	3,330	53.8
1975	—	28,300	3,151	29.6
1974	—	—	3,365	44.5
1973	—	—	3,424	38.0
1972	251	35,100	3,461	42.3
1971	—	—	—	33.8
1970	—	—	—	39.8

1. Value of industry shipments, not products, in 1982 dollars.

Source: Census of Manufactures.

Paperboard:

RECYCLED

Recycled paperboard typically consists of 100% wastepaper fiber and is produced on either a multiformer or fourdrinier paper machine. Recycled mills tend to be older, smaller, and less efficient than those found in other sectors of the industry, but this trend is changing as companies invest in capital improvements. Average size of recycled paperboard machines in the U.S. is about 140-tpd compared with about 490-tpd for solid bleached and 750-tpd for unbleached kraft board. However, recycled mills are usually located closer to their customers and fiber sources, thereby reducing shipping and materials costs and enabling them to provide quick response to customer needs.

Recycled paperboard includes such diverse grades as boxboard, containerboard, gypsum linerboard, and various types of industrial converting grades. Production capacity by major grade in 1989 breaks down as follows: folding boxboard, 26.8%; setup boxboard, 2.8%; corrugating medium, 19.4%; gypsum linerboard, 14.6%; linerboard, 6.2%; container chip and filler board, 0.5%; and other converting grades, 29.7%. The converting grades include nonpackaging and miscellaneous end uses such as tube, can, drum, tag, file folder, match stem, tablet backs, book cover, and game boards. Not included are various types of construction paper and board (except for gypsum wallboard liner).

Boxboard grades usually consist of four or more plies. The top layer is made from deinked pulp or other high-quality wastepaper such as one of the pulp substitutes. Middle plies are made with lower-quality paper stock, such as old news and mixed papers combined with some old corrugated containers for added strength. The fiber content of the bottom layer (or back ply) depends on the strength and appearance preferred in the finished product. Fiber choices include news, corrugated, and pulp substitutes.

Overall demand for recycled paperboard grades is growing slowly due to competition from virgin grades, plastic packaging, and declining end-use markets. Production during the last decade grew at an average rate of 1.7%. The fastest growth was in clay-coated boxboard grades, containerboard, and gypsum linerboard—a trend that is expected to continue. At the same time, uncoated boxboard, setup boxboard, and some miscellaneous uses have declined.

The combination of slow growth in many mature markets and rising energy and fiber costs caused several recycled mills to shut down in the 1970s.

The industry has also undergone a major period of consolidation during the past two decades. More capacity was retired from recycled paperboard than from any other sector of the industry, with over 2.7 million tons, or 34% of recycled paperboard annual capacity, taken out of production in the 1970s. Machine rebuilds offset the losses, however, keeping capacity relatively stable.

Between 1977 and 1986, recycled board capacity in-

U.S. STATISTICS FOR RECYCLED BOXBOARD AND PAPERBOARD

	1989e	1988	1987
Production, 000 tons[1]	8,673	8,789	8,602
Capacity, 000 tons	9,572	9,468	9,267
Utilization rate, %	90.6	92.8	92.8
Imports, 000 tons	95	143	151
Exports, 000 tons	70	72	76
Apparent U.S. consumption			
000 tons	8,698	8,860	8,677
lb/capita	70.1	72.2	71.4
000 tons/$ billion real GNP (1982)	2.18	2.27	2.27

e = Estimate.
1. All tons are short tons.

Sources: American Paper Institute, *Pulp & Paper* estimates.

creased just 176,000 tons for an average annual growth rate of 0.2%, according to the American Paper Institute. Much of this additional capacity resulted from the startup of Inland Container Corp.'s new 175,000-tpy Ontario, Calif., recycled linerboard mill in 1985.

Despite the removal of 100,000 tons of annual capacity in 1986 due to an idled mill, recycled board capacity rose 457,000 tons between 1985 and 1987—a 5.2% increase. Future capacity additions are expected to add another 300,000 tons—mainly in corrugating medium, linerboard, and folding carton—between 1988 and 1991. A good portion of this growth involves the conversion of several idle paper mills to recycled containerboard production, as well as more than 20 separate machine rebuilds and capacity expansions across the U.S. The resurgent demand for certain recycled packaging grades, combined with the increasing need to reduce solid waste, will sustain capacity growth in the next few years.

INDUSTRY STRUCTURE

Several companies such as Jefferson Smurfit Corp., Newark Group Inc., Sonoco Products Co., Caraustar Industries Inc., and Rock-Tenn Co. have expanded their positions in the industry, while others have sold off or closed their recycled board mills. Based in St. Louis, Mo., Jefferson Smurfit is by far the largest player in the industry with 1.2 million tons of annual capacity. It purchased 50% ownership of Container Corp. of America in 1986, but manages all of CCA's operations in the U.S. Jefferson Smurfit's other acquisitions include Alton Packaging Corp., two boxboard mills from Diamond International Corp., and one mill from Union Camp Corp.

RECYCLED COMBINATION PAPERBOARD, BOXBOARD, AND PACKAGING GRADES

Album board
Automobile board
Bending chipboard
Blister board
Can stock
Car lining board
Chipboard
Cracker shell board
Core stock
Corrugating medium
Drum stock
Florist board
Innersole
Jute board
Kraft-backed board
Laminating board
Lined board
Manila board
Matchbook board
Mat-finishing board
Moistureproof board
Mounting board
Newsboard
Offset blanks
Patent-coated
Pasteboard
Photo-mount board
Poster board
Pulpboard
Saturating board
Shoeboard
Test chipboard
Test linerboard
Transformer board
Tube stock
Wallboard
Water-resistant board
Waterproof board
Wet-strength board
White-lined board

The New Jersey-based Newark Group is the second-largest manufacturer of recycled paperboard products in the U.S., operating 11 paperboard mills nationwide with total capacity of about 840,000 tpy. Its recent acquisitions include Federal Paper Board Co.'s Los Angeles, Calif., recycled mill and National Gypsum Co.'s Stockton, Calif., mill.

Sonoco Products is the third-largest recycled paperboard producer, with an estimated 750,000 tpy of capacity. In 1987, the company bought Boise Cascade Corp.'s Consumer Packaging Div., making it the country's largest producer of composite cans, tubes, and cores. In 1988, the company purchased Federal Paper Board's Richmond, Va., recycled board mill.

Similar consolidation occurred recently in Canada, where Paperboard Industries Corp. of Toronto acquired Belkin Inc. of Vancouver, B.C. The combined company is by far the largest recycled paperboard producer north of the U.S. border, with an estimated 550,000 tpy of boxboard and containerboard production capacity at six mills.

Mead Corp. and Packaging Corp. of America both put their recycled board mills up for sale in 1987. PCA reached a tentative agreement to sell its recycled business to Republic Gypsum Co., but the deal later fell through, and PCA decided to keep the mills. Mead, however, successfully completed the sale of its recycled division (consisting of three mills) to Rock-Tenn in 1988. In 1989, Boise Cascade Corp. sold its specialty paperboard division to a private investment group. The transaction included four mills in New York and Vermont that produce a variety of chipboard and pressboard grades used in the manufacture of book covers, office supplies, graphic arts, and specialty boxboard.

One of the largest reductions in U.S. recycled board capacity occurred in 1980 when Whippany Paper Board Co. declared bankruptcy, idling 450,000 tpy. Some of the former Whippany mills have been sold and are expected to operate under new ownership. One company briefly operated the former Durham mill in Riegelsville, Pa., then sold it in 1985 to International Paper Co., which was still considering plans to reactivate it in early 1989. Whippany's Clifton, N.J., mill was sold to V. Ponte & Sons, a wastepaper dealer, which is expected to resume production in early 1990.

As a result of such activities, industry concentration increased significantly over the past decade. The total market

TYPICAL GRADE STRUCTURE FOR TEST LINERBOARD

Basis weight[1] (lb/1,000 ft²)	Caliper[1] (0.001 in.)	Mullen[1] (psi)
42	12	80-85
47	13	90
48/52	13/15	95/100
69	19	130

1. Tests are approximate. These grades supplied in other weights and at different levels of mullen.

share held by the ten largest U.S. recycled board producers grew from 42% in 1978 to approximately 60% in 1989.

Another interesting development is foreign investment in the U.S. recycled paperboard industry. In late 1986, Settsu Corp., the largest Japanese recycled paperboard producer, acquired approximately a 22% interest in Caraustar Industries, which has 525,000 tpy of capacity at ten mills in the southern and eastern U.S. The agreement is expected to involve some cooperation in marketing and possibly an exchange of technology.

Even more unusual was China National Packaging Corp.'s purchase of Morris Paper Board Co.'s 110-tpd mill at Morristown, N.J., in early 1986. The Chinese are operating the mill primarily to gain technical expertise, and they are shipping some production to People's Rep. China. Its ultimate fate, however, could be like that of the former 250-tpd Nabisco Inc. boxboard mill in Marseilles, Ill., which was acquired by Federal Paper Board. The equipment was then scrapped and sold to a Hong Kong firm in 1987.

The competitiveness of recycled paperboard mills continues to be affected by high energy costs (because these mills rely largely on purchased energy and have no spent pulping liquors or woodwastes to burn) and fluctuations in wastepaper costs. In 1986-87, wastepaper fiber prices skyrocketed, but prices for recycled paperboard products remained flat, so profits were substantially depressed. Conversely, when wastepaper prices are depressed due to oversupply, recycled mills have an edge over virgin grades because their raw material costs are extremely low. This is the scenario that developed during 1988-89.

Operating rates at recycled paperboard mills have improved steadily in recent years, rising from 86.8% in 1985 to approximately 92.7% in 1989.

RECYCLED FOLDING BOARD

Production of clay-coated recycled folding carton board was approximately 1.65 million tons in 1988. Other recycled folding boxboard grades, such as uncoated bending chipboard and white and kraft-lined grades, account for a smaller amount of total folding boxboard—about 710,000 tons in 1988.

The remainder of the folding carton market consists of solid bleached sulfate (SBS) and clay-coated unbleached kraft grades made mainly from virgin fiber. Because of competition from virgin grades and little new capacity, production of recycled boxboard for folding cartons has remained relatively stable at around 2.3 million tons, according to API statistics.

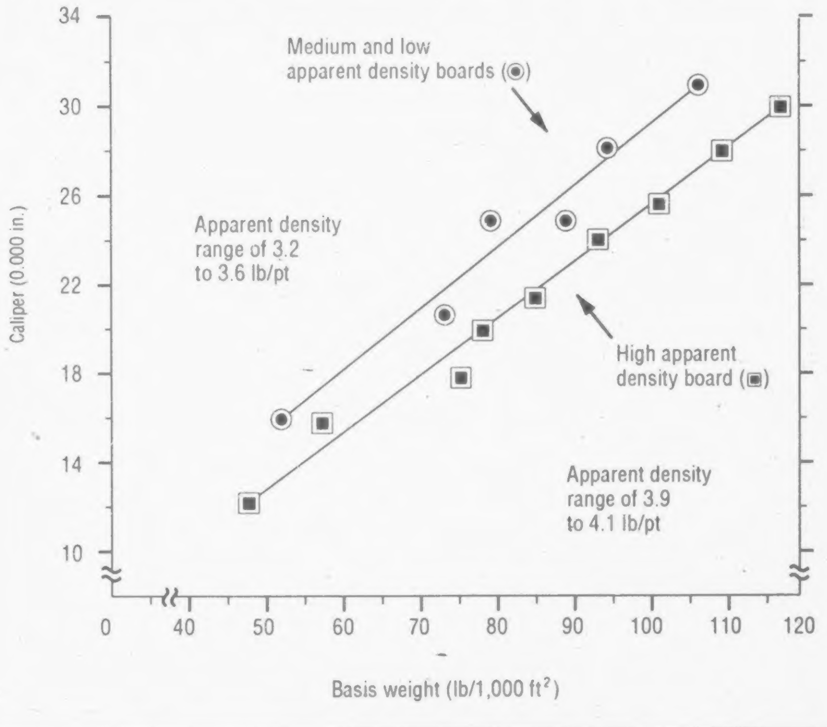
API reported that recycled paperboard's share of the domestic folding carton market dropped from 49.3% to 44.4% between 1978 and 1988. At the same time, unbleached kraft's share rose from 13.1% to 17.5%, while SBS's share remained relatively unchanged at about 38%.

Shifts in the mix of boxboard consumption during the past few years have largely been determined by fluctuating prices, by various environmental and political pressures to recover and recycle wastepaper, by existing supplies, and by changing demand patterns within the end-user markets (especially food and beverages). The relative stability in recycled boxboard production is linked to all these factors.

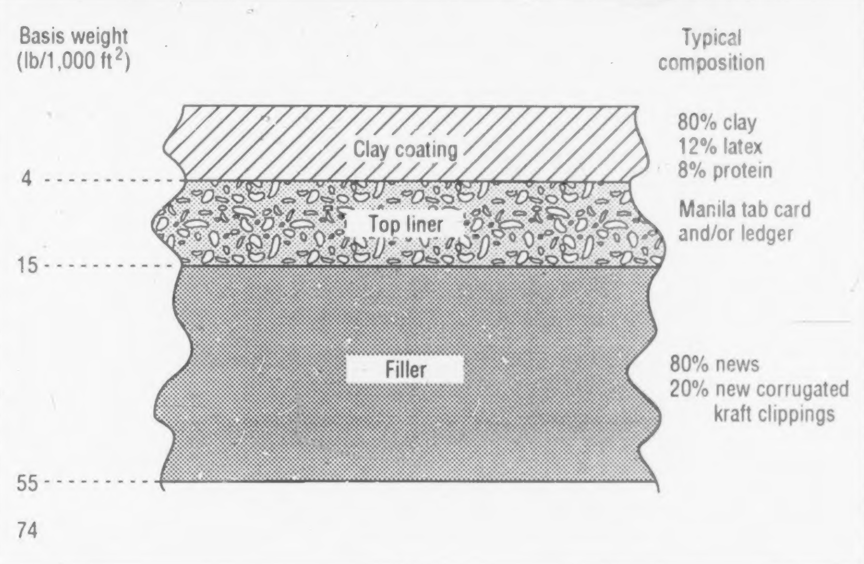
Clay-coated recycled boxboard, which is typically coated on only one side with on-machine coaters, is used to package non-food products such as soaps and detergents, hardware, toys, and lower-priced cosmetics. It is also used with foods that are first packaged in a bag or inner liner, such as cookies and dry cereals. Waxes, polyethylene, and other special coatings may be applied to give the package special properties. Clay-coated newsback is readily identifiable by the gray appearance of its unprinted side. Boards

TYPICAL GRADE STRUCTURE FOR BOXBOARD GRADES

(approximate relation between caliper and basis weight for high- and low-density boards)



COMPOSITION OF 18-POINT CLAY-COATED FOLDING BOXBOARD


Basis weight
(lb/1,000 ft^2)
Typical composition
4
15
55
74
Clay coating
Top liner
Filler
80% clay
12% latex
8% protein
Manila tab card and/or ledger
80% news
20% new corrugated kraft clippings

U.S. PRODUCTION OF BOXBOARD GRADES—FOLDING AND SETUP

(000 short tons)

		Recycled folding boxboard[1]				
Year	Total folding	Unlined chipboard	Kraft lined	White lined	Clay coated	Total setup boxboard[2]
1988	2,550	546	137	117	1,751	302
1987	2,561	537	162	130	1,731	240
1986	2,284	441	219	168	1,456	273
1985	2,268	468	203	193	1,404	259
1984	2,310	471	168	224	1,447	307
1983	2,369	585	180	227	1,377	263
1982	2,152	546	146	152	1,308	238
1981	2,425	n.a.	176	189	n.a.	298
1980	2,350	606	81	220	1,443	560
1979	2,386	678	98	229	1,380	604
1978	2,469	706	131	247	1,384	687
1977	2,423	687	133	274	1,330	717
1976	2,508	707	145	313	1,343	747
1975	2,108	564	124	274	1,146	672
1974	2,423	697	137	439	1,149	796
1973	2,652	740	146	520	1,246	998
1972	2,656	793	140	533	1,190	985
1971	2,575	n.a.	n.a.	n.a.	n.a.	979
1970	2,727	n.a.	n.a.	n.a.	n.a.	1,042
1969	2,852	n.a.	n.a.	n.a.	n.a.	1,164

n.a. = Not available.

1. Bureau of the Census defines as combination bending board.

2. Bureau of the Census defines as combination nonbending board. These boards are used to produce rigid paperboxes, among other uses.

Source: Bureau of the Census.

that utilize a kraft backing are identified by their brown, unprinted side.

Quality and productivity have been upgraded at several recycled folding boxboard mills by replacing older cylinderboard machines with multi-ply formers. Innovations such as the Ultra Former enable mills to compete more effectively with coated solid bleached and unbleached boards, which are the major competitors of recycled boxboard. A lower-density sheet can be produced on these formers more effectively than on conventional cylinder machines—3.9 to 4.2 lb/pt on traditional cylinderboard machines vs 3.4 to 3.8 lb/pt on newer formers.

Total folding carton shipments increased about 4.0% annually from 1986 to 1988, according to the Paperboard Packaging Council. Strong growth in folding carton shipments can be explained by strong growth in U.S. consumer spending. The recent strength in folding carton markets is encouraging; however, because demand is highly dependent on consumer spending, it is unlikely that current growth rates will be sustained. The annual growth rate over the next few years will likely drop to about 1.4%, according to one industry estimate.

RECYCLED SETUP BOXBOARD

Pre-formed rigid boxes are the primary use for setup boxboard, also called nonbending paperboard or boxboard. Grades include plain chipboard, filled news, news vatlined chip, and white vatlined chip. These grades can be pasted or laminated to form nonbending boards of greater thickness. Setup paperboard is usually overwrapped with specialty grades of paper for a more attractive box. Candy, stationery, jewelry, and toiletries are among the most common end uses for setup boxes.

Setup boxboard is usually made from wastepaper of a lower grade than that used for folding cartons, because bending and scoring requirements are lower for setup boxes. Setup boxboard grades are generally produced in the 14-to-65-pt caliper range. Higher-caliper grades ranging from 60 to 150 pt can be produced by pasting lower-caliper grades together.

The traditional rigid box is much more expensive to produce than a folding carton. Therefore, it is typically used to package expensive goods in uniquely designed boxes that reflect the product's high quality.

Because demand for rigid boxes has decreased, due mostly to competition from folding cartons, production of setup boxboard has also declined—from a peak of about 600,000 tons in the 1950s to about 250,000 tons in 1988. Declining demand for setup boxes has also caused a significant amount of consolidation among setup box converters, but the market has stabilized in recent years.

The industry is moving ahead by cutting costs and boosting productivity, diversifying its product mix, and opening new market areas. Converters have improved product design, appearance, graphics, and color printing through use of better inks and ink-curing processes, as well as through new processing and coating techniques that improve strength and moisture resistance of rigid boxes.

Such moves should help setup boxes carve out a bigger niche in the market for special-purpose, higher-value, luxury packaging. The Dept. of Commerce forecast about a 1.5% annual rise in the real value of setup paperboard box shipments between 1987 and 1991. Cosmetics, pharmaceuticals, confectionery, and electronics are expected to be growth areas for this custom packaging. Competition will persist from other packaging, especially folding cartons and molded plastic containers, but setup board should retain much of its market share for specialty packaging.

U.S. PRODUCTION OF SPECIAL RECYCLED PACKAGING AND INDUSTRIAL CONVERTING PAPERBOARDS

(000 short tons)

Year	Total	Gypsum linerboard	Tube, can, and drum stock	Panelboard wallboard stock	Others
1988	3,123	1,239	1,145	35	704
1987	3,070	1,227	1,124	48	671
1986	2,950	1,145	1,043	64	698
1985	2,814	1,079	1,021	68	646
1984	2,772	915	1,064	150	643
1983	2,406	798	858	148	602
1982	2,119	750	767	119	635
1981	2,144	809	634	100	601
1980	2,262	1,036	564	113	548
1979	2,543	1,210	628	137	568
1978	2,453	1,185	601	119	546
1977	2,378	1,099	680	113	485
1976	2,205	963	701	86	454
1975	1,913	821	630	67	395
1974	2,228	960	733	67	467
1973	2,403	1,051	763	94	493
1972	2,278	1,053	728	117	380
1971	2,048	936	641	105	366
1970	1,739	807	573	90	270
1969	1,771	847	527	113	285

Source: Bureau of the Census.

CONTAINERBOARD

Recycled containerboard grades—linerboard and corrugating medium—are produced on fourdrinier or cylinder board machines. Recycled linerboard, also known as test linerboard, is usually made with old corrugated containers in the fiber furnish. It is manufactured to a specific burst or mullen strength (e.g., 95 to 100 psi to be equivalent to 42-lb linerboard produced from virgin kraft fiber).

A mill usually produces a higher sheet weight in order to make test linerboard equivalent to virgin linerboard. For example, a 100-lb test linerboard might have a basis weight of 48 to 50 lb/1,000 ft^2, compared with 42 lb/1,000 ft^2 for virgin linerboard.

Recycled linerboard demand has increased at a strong 7.6% annual rate since 1978, reaching an estimated 500,000 tons in 1988. Currently, recycled linerboard supplies about 3.0% of total domestic linerboard demand, but this figure should increase to about 5.0% during 1990-91 as more producers use wastepaper in their fiber furnish. Demand for recycled linerboard is strongest when the kraft linerboard market is tight, but demand can fall off sharply during an economic downturn.

Production of recycled linerboard is expected to increase in the U.S., due to a limited supply of kraft linerboard and the low capital cost of installing new recycled capacity. Capacity will increase sharply in the next few years because several idle mills will be reopened under new ownership and because at least one new greenfield mill will be built to produce recycled linerboard and corrugating medium.

Recycled corrugating medium is more accepted in the U.S. as a substitute for semichemical medium, and this trend has fueled a sharp increase in capacity. Recycled corrugating medium production in 1988 was an estimated 1.85 million tons, representing about 25% of all corrugating medium used domestically.

Major producers of recycled medium and linerboard include Inland Container, Jefferson Smurfit, Gaylord Container Co., Chesapeake Corp., and Menominee Paper Co., and Stone Container Corp. In Canada, Paperboard Industries and Cascades Inc. are the major producers of recycled containerboard. In late 1988, Nolichucky Industries Corp. declared bankruptcy, resulting in the shutdown of about 180,000 tons of recycled containerboard production capacity at three mills. Two foreign firms—Australia's Pratt Group and Japan's Daishowa Paper Manufacturing Co.—have announced plans to construct and operate new recycled containerboard mills in the U.S.

RECYCLED INDUSTRIAL/CONVERTING PAPERBOARD

Gypsum linerboard, which is used as the front and back liners for gypsum wallboard, is generally made by large, integrated producers of construction papers and board. Major

U.S. PRODUCTION OF RECYCLED SHIPPING CONTAINERBOARD GRADES

(000 short tons)

Year	Total	Liner-board	Corrugating medium	Chip and filler boards
1988	3,186	976	2,061	149
1987	3,131	1,029	1,950	152
1986	2,495	761	1,568	167
1985	2,560	918	1,486	157
1984	2,407	846	1,397	164
1983	2,565	879	1,519	167
1982	2,097	504	1,427	165
1981	1,750	250	1,315	185
1980	2,070	518	1,281	271
1979	2,050	460	1,301	290
1978	1,981	332	1,408	242
1977	1,908	379	1,286	243
1976	1,470	227	1,040	202
1975	1,129	196	786	145
1974	1,766	454	1,114	198
1973	1,741	295	1,204	241
1972	1,476	279	942	255
1971	1,390	263	879	248
1970	1,522	321	916	285
1969	1,624	402	939	283

Source: Bureau of the Census.

CANADIAN PRODUCTION OF BOXBOARD GRADES

(000 metric tons)

Year	Folding	Non-folding	Other*	Total
1988	424	61	238	723
1987	435	63	244	742
1986	331	97	298	726
1985	324	94	279	697
1984	329	129	299	757
1983	322	116	268	704
1982	277	104	245	627
1981	300	118	298	716
1980	281	107	292	680
1979	286	108	338	731
1978	247	121	321	689
1977	216	121	280	617
1976	203	73	247	525
1975	174	92	216	482
1974	231	129	288	647
1973	242	96	274	612
1972	248	86	271	605
1971	238	91	240	569
1970	234	93	243	570
1969	239	95	248	582

* Includes liner for gypsum or plaster board, and mill wrapping.

Source: Canadian Pulp & Paper Assn.

producers include U.S. Gypsum Co., National Gypsum, Georgia-Pacific Corp., Celotex Corp., Republic Gypsum, and Domtar Inc. Nonintegrated producers, however, may sell small amounts. Recently, both National Gypsum and U.S. Gypsum sold recycled paperboard mills that produce gypsum linerboard.

Demand for gypsum linerboard is closely linked to demand for wallboard. As a general rule, about 50% of gypsum wallboard is used in construction of new family housing, 20% in nonresidential buildings, 20% in repair and remodeling, and the remaining 10% in other uses. Because few products offer comparable value at such low prices, the market is expected to stay strong in the long term. In the short term, however, demand may fluctuate significantly because it follows the general construction and housing market and interest rates. During 1984-88, U.S. production fluctuated between 1.1 and 1.2 million tons/year.

Tube, can, core, and drum products comprise one of the largest markets for recycled paperboard. These end uses consume about 15% of total recycled paperboard production, amounting to an estimated 1.25 million tons in 1988. Approximately 150,000 tpy of unbleached kraft paperboard and a small amount of semichemical paperboard are also used in these products.

Within this sector, the largest market is fiber-based tube, drum, and core stock, which accounts for 70% of volume.

The industry is highly integrated, with paperboard producers such as Sonoco Products and Jefferson Smurfit having converting operations at their own mills or nearby. Most mills and converting facilities are located near the industrial markets they serve because of high shipping costs on bulky cores, drums, or tubes. U.S. Paper Mills Corp., for example, specializes in supplying lightweight core stock to the many tissue and towel converting operations located in Wisconsin.

Greif Bros. Corp. is the largest independent converter of industrial fiber drums.

Industry structure underwent a substantial shift during the 1980s. In 1982, Container Corp. of America and Owens-Illinois Inc. left the business. CCA sold its composite can division to Sonoco, but retained its plastic drum business. Sonoco later added to that acquisition by buying Continental Fibre Drum Inc.'s 13 plants early in 1985, and it acquired Plast-Drum Inc. in 1986 to expand into plastic industrial drums. In 1987, Sonoco purchased the Consumer Packaging Div. of Boise Cascade, which included 27 composite can and/or plastic bottle plants. Meanwhile, Jefferson Smurfit acquired CCA's plastic drum business in 1986, adding it to the industrial fiber drum business it acquired from Alton Packaging. Another major player in the market

U.S. FOLDING BOXBOARD MARKET SHARE BY GRADE

(000 short tons)

		Recycled		Solid bleached sulfate (SBS)		Coated unbleached kraft	
Year	Total	Ton	Share	Ton	Share	Ton	Share
1988	5,292	2,352	44.4%	2,016	38.1%	924	17.5%
1987r	5,210	2,342	45.0	2,003	38.4	865	16.6
1986r	5,056	2,256	44.6	1,911	37.8	889	17.6
1985r	4,805	2,241	46.7	1,742	36.2	822	17.1
1984	4,876	2,277	46.7	1,847	37.9	752	15.4
1983	4,646	2,211	47.6	1,725	37.1	710	15.3
1982	4,334	2,076	47.9	1,567	36.2	691	15.9
1981	4,588	2,260	49.3	1,655	36.1	672	14.6
1980	4,490	2,234	49.8	1,575	35.1	680	15.1
1979	4,721	2,309	48.9	1,714	36.3	698	14.8
1978	4,702	2,321	49.4	1,763	37.5	618	13.1
1977	4,547	2,367	52.1	1,592	32.8	588	12.9
1976	4,715	2,340	49.6	1,797	38.1	578	12.3
1975	3,896	1,978	50.8	1,456	37.4	463	11.9
1974	4,427	2,281	51.5	1,676	37.9	470	10.6
1973	4,705	2,522	53.6	1,728	36.7	455	9.7
1972	4,440	2,477	55.8	1,573	35.4	390	8.8
1971	4,139	2,408	58.2	1,392	33.6	340	8.2
1970	4,080	2,473	60.6	1,263	31.0	343	8.4
1969	4,262	2,629	61.7	1,346	31.6	287	6.7
1968	4,218	2,730	64.7	1,227	29.1	261	6.2

r = Revised.

Source: American Paper Institute.

is Caraustar Industries' affiliate Star Paper Tube Inc., which bought Apache Products Inc. early in 1985, bringing to 17 the total number of its tube and core plants. Later in 1985, Clevepak Corp. indicated it would sell its Container & Core Div. to an employee group.

While paperboard use in industrial tube, drum, and core products grew about 1.5%/year during the past decade, use of composite cans for packaging declined sharply. Virtually all motor oil packaging has shifted from composite cans to plastic containers, and frozen juice concentrate and other food products have changed to plastic containers as well.

The continuing downward spiral of composite fiber cans is the main reason for low growth in this segment. Competition from plastic cans, flexible plastic pouches, aseptic containers, and paperboard, metal, and glass containers caused sales of composite cans to drop an estimated 7.0% in volume in 1985-86. This compares with a loss of 8.5% during 1984-85, according to the Dept. of Commerce. Through 1987, the decline in the value of shipments of fiber cans, drums, and similar products eased slightly, falling only 3%. During 1987-91, the industry is expected to grow at an inflation-adjusted annual rate of 1%. The composite fiber can sector will improve modestly, with increased shipments for such end uses as pet food, snack food, powdered drink, frozen food, and nonfood containers. (See section on converted paper and board products.)

Basestocks for tube, core, and drum products are produced in a variety of basis weights and compositions. For cores, the principal test is crush resistance. Typically, an outer ply of virgin kraft paperboard in a 13-pt caliper range is used for core stock. The inner layers are made from semichemical furnish, high-yield kraft, or recycled furnish. In most cases, recycled paperboard cores use a 17-pt caliper core stock. In making core or tube stock, parent rolls are cut into rolls about 5 in. wide. Standard cores have a 3-in. diameter and varying wall thicknesses, with $^3/_8$-in. and $^1/_2$-in. wall thicknesses being common.

Panel and wallboard stocks are used to manufacture thick, rigid boards used in home construction, automobiles, and trailers. Basestock is produced on cylinder board machines and then pasted or laminated together to make panels or wallboards of different thicknesses. Wall and panelboard stocks are made by a limited number of producers. The long-term market for these grades is static, although demand tends to fluctuate with the levels of trailer production and new construction. Approximately 115,000 tons of recycled paperboard are used annually in these applications.

Other recycled paperboard includes a wide range of specialty board used in display boards, book bindings, game boards, etc. Specialty uses are expected to continue growing, although at a modest rate with limited production.

These miscellaneous applications consume approximately 200,000 tons of recycled paperboard annually.

U.S. AND CANADIAN CAPACITY FOR RECYCLED PAPERBOARD

(000 short tons)

	U.S. annual capacity					Canadian annual capacity
		Recycled paperboard grades				
Year	U.S. total	Paperboard[1]	Folding and setup	Gypsum liner	Other[2]	Total boxboard including bleached board
1990e	9,727	2,647	2,857	1,347	2,876	825
1989e	9,572	2,496	2,844	1,387	2,845	803
1988	9,468	2,457	2,838	1,387	2,785	777
1987	9,268	2,240	2,936	1,386	2,706	773
1986	9,008	2,089	2,934	1,349	2,637	775
1985	8,795	1,998	2,929	1,265	2,603	798
1984	8,722	2,145	2,922	1,249	2,405	798
1983	8,692	2,068	2,995	1,217	2,412	767
1982	8,690	2,130	3,007	1,255	2,298	758
1981	8,600	2,121	2,968	1,251	2,260	792
1980	8,617	2,122	2,942	1,238	2,313	807
1979	8,757	2,111	3,019	1,273	2,355	861
1978	8,642	2,015	2,986	1,238	2,403	851
1977	8,699	2,132	3,117	1,112	2,337	796
1976	8,774	2,235	3,155	1,046	2,337	747
1975	8,717	2,221	3,123	1,063	2,310	744
1974	8,680	2,132	3,170	1,100	2,278	714
1973	8,330	1,833	3,182	1,093	2,221	681
1972	8,185	1,785	3,109	1,082	2,209	659
1971	[illegible]078	1,652	3,292	1,031	2,104	—
1970	[illegible]084	1,697	3,381	1,013	1,993	—

e = Estimate.

1. Includes linerboard, corrugating medium, and container chip and filler board.

2. Others include tube, can, and drum stock, special packaging boards, and panel and wallboard stocks.

Sources: American Paper Institute, Canadian Pulp & Paper Assn.

FORMING METHODS

During the last two decades, recycled cylinder board grades lost much of their competitive advantage to fourdrinier board grades in folding carton packaging. On a fourdrinier paper machine, SBS boards can be produced at higher speeds and with somewhat lower density and machine-direction/cross-direction (MD/CD) stiffness or grain ratio than recycled paperboard grades. The fourdrinier, however, is limited in the caliper ranges that it offers. SBS boards are usually produced in calipers ranging from 10 to 28 pt, although they rarely exceed 20 pt.

Cylinder board machines usually produce boards in calipers ranging from 16 to 45 pt, with most cylinder machines able to produce a wide range of combination paperboard, folding and setup boxboards, corrugating medium, gypsum linerboard, and chipboards.

Outside North America, a substantial amount of test linerboard is produced on multi-ply formers. The typical cylinder machine with an open stock-flow system and conventional cylinder mold and vat is limited in its performance. Due to centrifugal forces, it is difficult to operate a conventional cylinder board machine at speeds over 600 fpm. Such grades would have a tensile ratio of 4:1 (MD/CD) and no better than 3:1.

The conventional cylinder mold rotates opposite to the stock flow (counterflow vat). Stock is formed on a wire-covered cylinder mold by pressure differential inside and outside the cylinder mold. The sheet, or ply, is couched off the top of the cylinder by a felt and ply. Counterflow systems produce a sheet with a high MD fiber orientation. As speed increases, sheet formation becomes poorer; with significant variations in the sheet, weight pickup decreases.

Sheet formation can be improved somewhat by using a direct vat where cylinder mold rotation is in the same direction as stock flow. Any additional improvement in formation can be achieved by using a dry vat. The dry-vat principle, also called "half-vat," was developed by the Boxboard Research & Development Assn.

Conventional cylinder formers can be upgraded in several ways. The easiest, least expensive method is to add new slice or headbox designs (pressure formers) to existing cylinder machines. This results in better control over grain ratios and improved dewatering. However, such units have limited speed and rarely exceed 600 fpm. Units such as the Beloit Corp.'s Stevens Former and Sandy Hill Corp.'s Rotoformer use vacuum suction to increase dewatering.

In the late 1960s, Kobayashi Engineering Works Ltd. introduced its first former, which it called the Ultra Former. This series became known as cylinder-on-top formers, wherein the sheet is formed and dewatered on top of a cylinder mold or drilled shell, then it travels downward from the slice to be transferred to the top of a carrier felt of fabric.

The Kobayashi former was designed to replace individual vats on cylinder machines. The Ultra Former permits the felt pickup to wrap the cylinder mold, thus eliminating dropoff, a problem common to conventional cylinder vat machines. The Ultra Former also produces a somewhat lower-density sheet than is possible with conventional cylinder machines.

Another new former, the on-top cylinder former with dewatering wires, is designed to be used with fourdrinier formers, but it can sometimes be used in place of a conventional cylinder vat.

Multi-ply boards can also be produced on modified fourdrinier machines in two ways: small fourdriniers are positioned on top of a long fourdrinier section, or on-top formers are positioned on top of a fourdrinier section. Beloit has a different approach for making lightweight multi-ply on a fourdrinier. It uses a headbox (Strata-Flo/Converflo) that can simultaneously deliver a two- or three-ply sheet to ei-

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/PAPERBOARD OF MAJOR U.S. COMPANIES, 1988

	Company	Annual capacity (000 short tons)	Grades*
1	Jefferson Smurfit[1]	1,220	CB, BB, CM, LB, CS, TS, SP
2	Newark Group[2]	840	CB, BB, CM, PB, TS, SP, GL
3	Sonoco Products[3]	750	PB, CS, DS, TS, SP
4	Rock-Tenn[4]	532	CB, BB, GL, CS, SP, PB, TS
5	Caraustar Industries[5]	480	BB, GL, PB, CS, TS, SP
6	Inland Container[6]	475	CM, LB
7	Waldorf[7]	380	BB, CS, DS, TS, CB
8	U.S. Gypsum	332	GL
9	Georgia-Pacific	235	GL
10	National Gypsum	215	GL, PB, CB, BB, CS, TS, SP
11	Packaging Corp. of America[8]	210	CB, BB, PB, CM, LB, GL
12	Federal Paper Board[9]	175	CB
13	James River	175	CB, BB, CM, LB
14	Simkins Industries[10]	160	CB, BB, SP
15	Republic Gypsum	135	BB, CS, GL, SP, TS

* = Code: BB-uncoated boxboard; CB-coated boxboard; CM-corrugating medium; CS-core stock; DS-drum stock; GL-gypsum liner; LB-linerboard; PB-unspecified paperboards; SP-specialty paperboards; TS-tube stock.

1. Reflects combined operations with Container Corp. of America, a 50%-owned affiliate.
2. Bought Lawrence Packaging Corp.'s Lawrence, Mass., mill in 1985; Federal Paper Board Co.'s Los Angeles, Calif., mill in 1988; and National Gypsum's Stockton, Calif., mill in 1989.
3. Bought Federal Paper Board Co.'s Richmond, Va., mill in 1988.
4. Bought Stroudsburg Paperboard Corp.'s mill in 1984. Bought Mead Corp.'s mills at Lynchburg, Va.; Cincinnati, Ohio; and Otsego, Mich., in 1987.
5. Bought CCA's mills at Chattanooga, Tenn.; Cincinnati, Ohio; and Chicago, Ill., in 1984. Bought U.S. Gypsum's Camden, N.J., mill in 1988.
6. Subsidiary of Temple-Inland Inc. Started up new 175,000-tpy test linerboard mill in Ontario, Calif., in late 1985.
7. Company formed to buy former St. Regis Corp. boxboard mills at St. Paul, Minn., and Battle Creek, Mich., from Champion International Corp. in 1985.
8. In 1983, sold two chipboard mills to Republic Gypsum Corp. and a clay-coated mill in Stroudsburg, Pa. (later sold to Rock-Tenn Co.).
9. Sold Richmond, Va., and Los Angeles, Calif., mills in 1988.
10. Bought Lowe Paper Co. in 1984.

ANNUAL U.S. CAPACITY FOR RECYCLED FOLDING AND SETUP BOXBOARDS

(000 short tons)

Year	Folding	Setup
1990e	2,587	270
1989e	2,562	268
1988	2,571	267
1987	2,661	275
1986	2,662	272
1985	2,640	289
1984	2,626	296
1983	2,681	362
1982	2,676	352
1981	2,638	321
1980	2,593	349
1978	2,568	418
1976	2,705	450
1974	2,665	505
1972	2,607	502
1970	2,805	576
1969	3,029	577

e = Estimate.

Source: American Paper Institute.

U.S. EXPORTS AND IMPORTS OF RECYCLED PAPERBOARD[1]

(000 short tons)

Year	Exports	Imports
1988	283	86
1987	329	81
1986	199	78
1985	246	68
1984	169	69
1983	150	50
1982	158	31
1981	174	40
1980	249	57
1979	176	42
1978	203	47
1977	268	28
1976	306	13
1975	262	8
1974	283	34
1973	207	33
1972	163	8
1971	168	17
1970	151	10
1969	143	11

[1] Bureau of the Census data for total recycled-furnish paperboard, including test containerboard and other paperboard.

ther a fourdrinier wire or a twin-wire former.

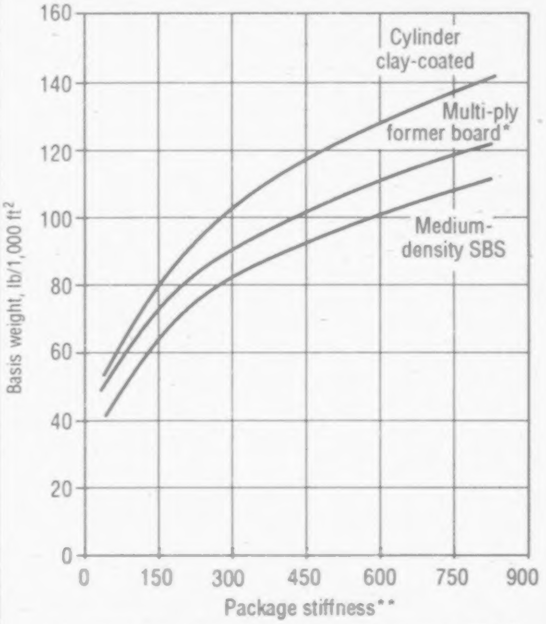
Twin-wire formers made an early debut into multi-ply forming, but they were used only on a limited basis until the 1970s. The first twin-wire former was jointly developed by St. Anne's Board Mill in the U.K. and Walmsley Ltd. (Beloit). It was called the Inverform, and it became the forerunner of all twin-wire formers. Inverform units were placed over a conventional fourdrinier table, and considerable dewatering was achieved through the top wire via drainage in an upward direction.

By the 1970s, several machine manufacturers had developed their own versions of twin-wire formers. Based on its experience with the Inverform, Beloit developed its Bel Bond former, which has better dewatering and speed characteristics and, like the Inverform, can be positioned over a fourdrinier wire to form a multi-ply board.

Kobayashi's Ultra Former, introduced in 1975, combines flat-forming and centrifugal water removal with a second fabric wire, but the sheet is formed before the twin forming fabrics meet. The sheet is transferred to a felt where it is plied to the preceding layer carried by the felt.

COMPARISON OF PACKAGE STIFFNESS FOR GIVEN FIBER WEIGHT

(SBS board produced on fourdrinier machines, recycled fiber board made on conventional cylinder and on multi-ply formers)



*Assumes basic board density at 3.5 lb/point/1,000 ft^2 coating weight at 8 lb/1,000 ft^2.

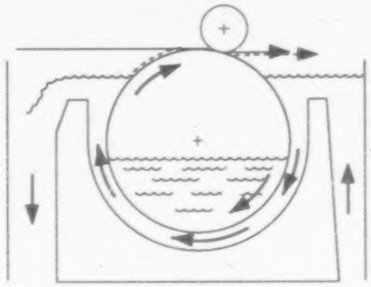
**Package stiffness = (MD stiffness)$^{0.33}$ x (CMD stiffness)$^{0.66}$

Source: Fibreboard Corp. and Arthur D. Little Inc.

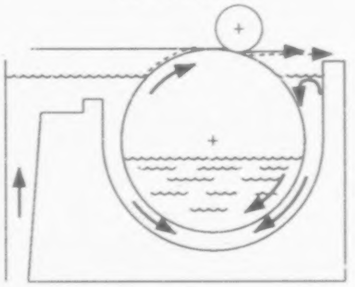
Source: Pulp & Paper, December 1978.

COUNTERFLOW VAT VS DIRECT-FLOW VAT

Direct-flow vat



Counterflow vat



Source: Pulp & Paper, December 1978.

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/PAPERBOARD OF CANADIAN COMPANIES, 1988

Company	Annual capacity (000 short tons)	Grades*
Paperboard Industries[1]	550	CB, PB, CM, LB, GL, CS
Atlantic Packaging	140	CM, LB
Beaver Wood Fibre[2]	122	BB, PB, TS, GL
Kruger	103	LB, CS, TS
Domtar	90	LB, CM
Sonoco Products	77	PB, CS, TS
Strathcona Paper	61	BB, PB, SB, CB
Minas Basin Pulp & Paper	35	BB, PB, CS, LB, TS, PB
Others	135	

* Code: BB-uncoated boxboard; CB-coated boxboard; CM-corrugating medium; CS-core stock; DS-drum stock; GL-gypsum liner; LB-linerboard; PB-unspecified paperboard; SP-specialty paperboard; TS-tube stock.

[1] Bought Belkin Inc. in 1987.

[2] Subsidiary of Georgia-Pacific Corp.

U.S. PRICES FOR RECYCLED BOXBOARD GRADES

($/short ton)

Year	20-pt clay-coated 80 bright (rolls)	20-pt chipboard bending (rolls)
1989		
2Q	$480/510	$340
1Q	480/510	340
1988		
4Q	450/475	340
3Q	440/460	340
2Q	410/430	340
1Q	410/430	320
1987		
4Q	380/400	320
3Q	380/400	320
2Q	355/375	320
1Q	355/375	320
1986		
4Q	380/420*	320*
3Q	370/410*	310*
2Q	370/400*	300*
1Q	350/400*	300*
1985		
4Q	350/400*	300*
3Q	350/400*	300*
2Q	370/425*	300*
1Q	370/425*	300*
Year-end		
1984	370/425*	300*
1983	370/425*	280/300*
1982	380/425*	280*
1981	400/425*	270/280*
1980	380	275
1979	355	260
1978	305	225
1977	284	219
1976	262	212
1975	257	204

* Discounting reported from list prices. Prices on both grades highest on the West Coast and lowest in the Midwest, except for 1987 when prices in the East were lowest.

Source: *Pulp & Paper Week.*

Fiber:

PULPING PROCESSES

Before paper can be made, papermakers must be furnished with a supply of fibers capable of producing a paper or board grade with desired strength properties and good runability on paper machines. The primary sources of fiber for papermaking are (1) pulpwood, (2) wastepaper, (3) nonwood fibers, and (4) inorganic fibers. In the U.S., about 1% of the fiber supplied for paper and board making is from nonwood and inorganic sources such as asbestos or bagasse. About 74% of the fiber supply is derived from pulpwood and 25% from wastepaper.

Pulping is the chemical or mechanical process of freeing fibers from wood. The goal of pulping is to disintegrate or separate woodfiber into its individual fibers without reducing fiber lengths or damaging strength properties. Pulping is accomplished in two ways: by mechanical or chemical forces, or a combination of the two. There are many different mechanical and chemical processes for pulping (or cooking) pulpwood. Choice of pulping process depends mainly on the grade of pulp necessary to meet the strength requirements of a specific paper or board grade.

In mechanical pulping, mechanical energy from grinding or attrition is used to separate the fibers from one another. In chemical processes, strong chemicals and high temperatures are used to dissolve the binding material between fibers, and once these binding materials (lignins) are partially removed or dissolved, the fibers will separate with a minimum of mechanical action, referred to as refining.

PULPWOOD SUPPLY

Choice of pulpwood species depends on the mill's location and the paper or board grades it produces. In the U.S. South, the principal species used are southern pine, mixed hardwood, and oak. In the Pacific Northwest, the major species are Douglas fir, hemlock, western pine, and small amounts of western cedar, redwood, and spruce. In the U.S. Midwest, the species most often used are mixed hardwoods, oak, and spruce. In the U.S. and Canadian Northeast, the major species are eastern spruce, pine, balsam fir, and mixed hardwood (poplar, white birch).

Because of increasing pressure on available softwood timber supplies, the percentage of hardwood used for pulp production is expected to rise gradually. Hardwoods comprise about 40% of the commercial timber supply in the U.S., and about 21% of total timber volume in Canada. In the U.S., hardwoods have grown from only 10% of total pulp production in the mid-1940s to around 30% currently.

In Canada, however, hardwoods have accounted for only 10% of the pulp produced in recent years—a situation that partly reflects the Canadian industry's concentration on bleached softwood kraft pulp and newsprint. Hardwood use in Canada is expected to grow because of increased printing/writing paper production and because of market pulp expansion projects based on hardwood in Alberta.

Pulpwood is delivered to the pulp mill in either chips or logs. In the U.S. Pacific Northwest, about 65% to 70% of the pulpwood used is sawmill residue. The concept of getting the most value from a tree—first using logs for lumber or plywood, and then using the residuals from the sawmills for energy or pulpwood—has been practiced in the Northwest since the 1920s. This approach is increasingly finding acceptance in the U.S. South, where rotation cycles are being extended to yield more timber that can be processed into higher-value lumber and plywood. Within the next decade, as much as 50% of the pulpwood delivered to southern mills will be in the form of byproduct woodchips—up from about 30% currently. In the Northeast, both in Canada and the U.S., most of the pulpwood delivered to mills is in roundwood form; however, even in this area, the trend is toward using more sawmill chips.

A major drawback to the heavy use of residuals is that availability and cost of chips become tied to the housing cycle, which tends to be countercyclical to the pulp industry. The housing downturn in 1980 choked off the flow of byproduct residuals from Pacific Northwest sawmills at a time when pulp production was strong, and this triggered a sharp rise in chip costs. More recently, chip prices in the region have risen sharply due to environmental pressures to restrict harvesting of old-growth timber. As a result, pulp and paper mills in the region are trying to chip more low-value logs and use more wastepaper.

PULPING PROCESSES

North American pulp mills use five major pulping processes: (1) sulfate (kraft), (2) sulfite, (3) semichemical, (4) mechanical, and (5) defibrated. Each process produces a different quality and yield of pulp from wood. The mechanical and defibrated processes produce low-quality pulp (i.e., low in strength but high in yield). Semichemical pulp, which is produced mainly from hardwood, is an intermediate-quality pulp with medium levels of yield—60% to 80%. Chemical pulps have the highest quality of pulp, but their yields are the lowest—45% to 55%.

Major modifications exist within each pulping group. For example, sulfate pulping generates high-yield and low-yield pulps. Mechanical pulping features at least five modified processes, plus two minor chemical pulping processes: the soda process and the prehydrolyzed sulfate process. The soda process has a soda cook, and it uses either sodium hydroxide or soda ash to produce a medium-quality chemical pulp from hardwood species. The prehydrolyzed sulfate process produces a dissolving pulp (chemical cellulose) from either hardwoods or softwoods, and these are used to produce rayon, acetate, cellophane, or chemical cellulose.

BLEACHING PROCESS

After the pulping process, woodpulp still contains some lignin and must be bleached to improve brightness. Bleaching is accomplished by either removing the lignin (delignification) or decolorizing it with oxidizing or reducing chemicals. Major oxidizing chemicals are chlorine (C), sodium hypochlorite (H), chlorine dioxide (D), and hydrogen peroxide (P). Sodium hydrosulfite is a reductant. Alkali, usually sodium hydroxide or caustic soda (E), is used to extract solubilized lignin from the cellulose.

Brightness is measured optically by test instruments that indicate brightness points (GE, ISO, or Elrepho units used respectively in the U.S., Canada, and rest of the world).

U.S. WOODPULP PRODUCTION

(000 metric tons)

Year	Total all grades	Special alpha/ dissolving	Bleached sulfite	Un-bleached sulfite	Bleached and semibleached sulfate and soda* Softwood	Bleached and semibleached sulfate and soda* Hardwood	Un-bleached sulfate	Semi-chemical	Ground-wood and thermo-mechanical
1988	55,528	1,240	1,240	175	12,110	11,752	19,699	3,952	5,391
1987	54,024	1,190	1,151	155	11,807	11,246	19,451	3,852	5,173
1986	51,725	1,141	1,157	149	11,349	10,567	18,448	3,802	4,978
1985	49,121	1,065	1,238	178	11,001	9,525	17,700	3,653	4,763
1984	50,323	1,094	1,233	235	10,934	9,342	18,798	3,691	4,995
1983	47,586	1,144	1,186	281	10,377	8,772	17,772	3,458	4,597
1982	44,755	991	1,127	313	10,189	7,702	16,484	3,356	4,594
1981	47,212	1,227	1,273	362	10,552	7,656	17,757	3,560	4,826
1980	46,027	1,369	1,324	349	9,867	7,369	17,773	3,652	4,324
1979	44,781	1,360	1,250	358	9,359	7,024	17,762	3,681	3,985
1978	43,032	1,277	1,286	298	9,022	6,494	17,247	3,657	3,750
1977	42,319	1,329	1,499	353	9,016	5,909	16,697	3,516	3,999
1976	41,187	1,348	1,587	380	8,476	5,833	16,171	3,478	3,911
1975	36,838	1,241	1,505	332	6,457	5,114	13,814	3,102	4,003
1974	40,676	1,607	1,736	354	6,960	5,812	15,407	3,437	4,074
1973	41,084	1,517	1,742	338	6,646	5,479	15,955	3,531	4,393
1972	39,544	1,521	1,629	302	6,247	5,103	15,668	3,443	4,180
1971	37,211	1,528	1,503	334	5,915	4,616	14,373	3,256	4,279
1970	37,050	1,557	1,733	361	5,683	4,803	14,206	3,091	4,066
1965	28,855	1,348	2,077	454	3,961	2,822	10,695	2,606	3,540
1960	21,755	1,032	1,855	483	3,754	1,191	7,878	1,807	2,959
1955	17,570	892	1,732	586	2,659	646	6,962	1,264	2,450
1950	12,447	434	1,478	672	2,100		5,179	611	1,973

* Bureau of the Census data show that semibleached sulfate production declined from 1.729 million metric tons in 1970 to 1.078 million tons in 1980—the last year production was broken out; soda pulp production was last shown by Census at 181,000 tons in 1974.

Source: American Paper Institute.

Chemical pulp is bleached in large, multistage bleaching processes by sequential chemical and washing treatment. Choice of bleaching sequence depends on pulp type, chemical costs, capital costs, and environmental considerations. For kraft pulp, a typical bleaching sequence might be chlorine, caustic (alkali extraction), chlorine dioxide, caustic (alkali extraction), and chlorine dioxide (commonly represented as the CEDED process). Chlorine for many years was the major chemical used in the first stage of the bleaching process because of its low cost and effectiveness. Other common bleaching stages are peroxide (P) or hypochlorite (H). Additional chemicals may be added during each stage to make the bleach plant more efficient. For example, oxidative extraction is becoming more popular. Oxygen is mixed with pulp before the first extraction stage in order to reduce bleaching chemicals further downstream in the bleach line. Fully bleached chemical pulps have brightnesses in the 85 to 90 GE range. Semibleached pulps average 70 to 80 GE.

Reductive bleaching is used to brighten groundwood and deinked pulps. Some oxidating agents such as peroxides, chlorine, and hypochlorites are also used. These brighten pulps to only 55 to 65 GE, and often it is done in one stage of bleaching. Some producers use multistage bleach lines to achieve higher brightness—in the 80-to-82 range for new bleached chemi-thermomechanical softwood pulp mills using peroxide bleaching.

SULFATE OR KRAFT PROCESS

The sulfate or kraft process is the most widely used process for wood pulping. Since 1950, sulfate pulping has grown from 38% to 67% of North American capacity. About 170 kraft mills are located in the U.S. and Canada, with a combined capacity in 1989 of 56.3 million metric tons. Of this amount, U.S. mills accounted for 44.8 million tons and Canadian mills accounted for 11.5 million tons.

In this alkaline process, woodchips are cooked under high pressures and temperatures in a "white liquor" solution of sodium hydroxide and sodium sulfide. The chips are pulped in large pressure digesters by either batch or continuous processes for one to two hours at temperatures exceeding 170°C (338°F). Depending on the quality of pulp desired, the amount of alkali, length of cooking time, and degree of temperature are varied to produce pulps of high or low yield. The higher-yield pulps have a higher lignin content, and they are typically used for linerboard and the coarser grades of kraft papers. If a pulp is to be bleached, the kraft pulping stage employs stronger conditions to reduce the pulp's lignin content. Because softwood pulps have more lignin than hardwood pulps, additional chemical is required to cook the pulp to a particular lignin content.

The kraft process is very versatile. It produces good-quality pulps from nearly all hardwood and softwood species, its chemicals can be recovered economically in a straightforward recovery process, the technology is well understood, and it produces a strong, easily bleached fiber. The kraft process is also attractive from an economic standpoint because its waste material, called black liquor, can readily be washed from the pulp, concentrated, and burned for recovery of energy and chemicals. A well-designed linerboard mill can be 50% or more self-sufficient in energy by burning waste liquors.

The kraft process does have certain deficiencies: (1) capital requirements for constructing kraft pulp mills are extremely high (over $500,000/annual ton), and mills must be

U.S. PULPWOOD CONSUMPTION BY PULPING PROCESS

(000 cords or 128 ft^3)

	1988	1987	1986	1985	1984	1983	1980	1970
All processes, total	95,479	92,386	90,554	84,840	86,948	83,493	79,703	67,562
Dissolving and special alpha	3,492	3,014	2,866	2,551	2,544	2,776	3,378	3,673
Sulfite, total	3,174	2,915	n.a.	n.a.	n.a.	n.a.	3,494	5,016
Bleached	n.a.	n.a.	2,661	2,405	3,255	3,104	2,618	3,849
Unbleached and soda	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	876	1,167
Sulfate, total	77,256	75,085	72,175	66,536	68,611	65,322	62,408	49,366
Bleached and semibleached	41,148	39,600	36,671	33,340	33,968	32,427	30,110	22,327
Unbleached	36,108	35,485	35,503	33,832	34,643	32,895	32,299	27,039
Groundwood[1]	5,880	5,624	5,513	5,337	5,508	5,142	4,483	4,234
Semichemical	4,107	4,061	4,081	3,851	3,912	3,798	3,853	3,456
Defibrated or exploded	1,569	1,687	n.a.	n.a.	n.a.	n.a.	2,087	1,818

Note: Consumption by type of wood in 1986 was as follows (000 cords): all processes 62,961 softwood (s), 27,592 hardwood (h); dissolving 2,052 (s), 813 (h); bleached sulfite 1,434 (s), 1,227 (h); bleached sulfate 21,499 (s), 15,173 (h); unbleached sulfate 31,066 (s), 4,437 (h); groundwood 5,006 (s), 507 (h); and semichemical 192 (s), 3,889 (h).

n.a. = Not available.

[1] Includes chemigroundwood.

Source: Bureau of the Census.

TABULATION OF NORTH AMERICAN PULP AND PAPER MILLS

	Companies[1]	Establishments[2]	Paper mills[3]	Total pulp mills	Groundwood	Other mechanical[4]	Semichemical	Sulfite	Kraft	Miscellaneous[5]
Alabama	19	20	18	21	3	1	2	—	13	2
Alaska	2	2	—	2	—	—	—	2	—	—
Arizona	2	2	2	5	2	—	—	—	1	2
Arkansas	9	10	9	9	1	1	—	—	7	—
California	33	41	33	13	—	3	1	—	4	5
Colorado	2	2	1	—	—	—	—	—	—	—
Connecticut	20	21	10	1	—	—	—	—	—	1
Delaware	3	5	4	1	—	—	—	—	—	1
Florida	18	18	11	11	—	1	—	1	8	1
Georgia	31	32	21	20	3	1	1	—	12	3
Idaho	2	3	2	1	—	—	—	—	1	—
Illinois	20	22	11	2	—	—	—	—	—	2
Indiana	12	15	12	2	—	—	1	—	—	1
Iowa	2	2	1	1	—	—	1	—	—	—
Kansas	2	2	2	—	—	—	—	—	—	—
Kentucky	5	7	5	3	—	—	1	—	2	—
Louisiana	12	17	13	19	3	1	4	—	10	1
Maine	19	24	20	22	12	—	—	1	7	2
Maryland	5	5	4	2	1	—	—	—	1	—
Massachusetts	34	47	38	5	—	—	—	—	—	5
Michigan	36	40	37	11	2	1	3	—	3	2
Minnesota	12	14	12	11	6	3	—	—	2	—
Mississippi	13	15	11	9	2	2	—	—	5	—
Missouri	6	6	4	1	—	1	—	—	—	—
Montana	1	1	1	1	—	—	—	—	1	—
New Hampshire	18	20	14	2	—	—	1	—	1	—
New Jersey	25	31	17	3	—	—	—	—	—	3
New Mexico	1	1	1	—	—	—	—	—	—	—
New York	54	68	53	16	4	3	—	1	1	7
North Carolina	19	22	18	13	1	3	1	—	5	3
Ohio	36	42	32	11	—	3	2	—	1	5
Oklahoma	6	7	7	6	—	1	1	—	1	3
Oregon	16	24	17	21	6	3	3	—	7	2
Pennsylvania	45	50	37	8	—	1	2	1	3	1
Puerto Rico	1	1	1	—	—	—	—	—	—	—
South Carolina	12	12	11	11	3	1	2	—	5	—
Tennessee	18	19	13	11	2	1	2	—	2	4
Texas	15	17	12	10	3	1	—	—	6	—
Vermont	7	8	7	2	1	—	—	—	—	1
Virginia	20	21	14	11	2	1	3	—	4	1
Washington	18	26	19	24	6	1	3	6	7	1
West Virginia	2	2	2	—	—	—	—	—	—	—
Wisconsin	43	58	48	36	8	4	2	6	4	12
TOTAL U.S.	391	802	605	358	71	38	36	18	124	71
Alberta	5	7	3	4	1	1	—	—	2	—
British Columbia	25	39	13	34	14	1	—	1	18	—
Manitoba	5	5	4	5	2	1	—	1	1	—
New Brunswick	10	11	7	14	6	1	2	2	3	—
Newfoundland	2	3	3	5	3	—	—	2	—	—
Nova Scotia	5	5	4	8	4	—	—	3	1	—
Ontario	24	49	35	37	14	3	2	5	9	4
Quebec	43	77	55	69	33	8	2	10	10	6
Saskatchewan	2	2	2	1	—	—	—	—	1	—
TOTAL CANADA	98	198	126	177	77	15	6	24	45	10

1. Subsidiaries and autonomous divisions of parent companies are counted as separate units. Totals of this column reflect elimination of duplication of names in more than one state or province.
2. Includes headquarters units.
3. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines, and regardless of whether or not one or more pulp mills are located at the site.
4. Includes steam and hot water defibrated, exploded, shredded, cold soda, and chemimechanical woodpulp mills.
5. Includes deinking, rag, soda, rope, flax, bagasse, and cotton linters pulp mills.

Source: *1989 Lockwood-Post's Directory.*

built with special metals because the liquors from this process are very corrosive; (2) odor pollution, principally from the sulfur compounds emitted during pulping and recovery, is a serious problem, although most odor emissions can be controlled with modern pollution-abatement procedures; (3) pulp yield is rather low (45% to 55%); (4) explosions caused by molten smelt coming into contact with water are a safety hazard; (5) dioxins (in very low levels) are present in the discharge of bleached kraft pulp mills.

As previously noted, chlorine is used in the bleaching process of virtually all kraft pulp mills, and it is the chemical primarily responsible for the formation of chlorinated organic compounds such as dioxins and furans. (See chapters on U.S. and Canadian environmental spending and regulations.) Many new developments in process technology are aimed at reducing the use of chlorine in pulp bleaching; however, the chemical cannot be totally eliminated without a loss in pulp quality. One approach to chlorine reduction is the maximum removal of lignin before pulp enters the bleach plant. This technique can be broadly described as extended delignification, and it includes the Kamyr process of modified continuous cooking (MCC) in continuous digesters, Beloit's rapid displacement heating in batch digesters (RDH), and various types of oxygen delignification.

Oxygen delignification. This process was developed in the late 1960s and early 1970s in Scandinavia. It involves an oxygen reactor vessel located after brownstock washing and before the bleaching sequence. Because pulp entering the bleach plant has lower lignin content, chlorine usage is decreased and the bleach plant effluent contains less chlorinated organic compounds as well as BOD and color. Oxygen delignification was first developed as a high-consistency process; most new systems are medium consistency because of lower capital costs and better efficiency.

Over 50 oxygen delignification systems have been installed worldwide, of which about half are located in Scandinavia and Europe. About eight systems have been installed in North America, and over a dozen more have been announced for new or existing mills. One problem with retrofitting an existing mill with oxygen delignification is the increased load (4% to 5%) on the chemical recovery system. As a result, oxygen delignification may not be attrac-

U.S. WOODPULP CAPACITY TRENDS

(000 short tons)

Year	Total all grades	Dissolving and special alpha	Total sulfite[1]	Bleached* softwood sulfate[2]	Bleached* hardwood sulfate[2]	Unbleached sulfate	Semichemical[3]	Mechanical	Screenings
1991e	67,754	1,402	1,591	14,899	13,629	23,849	5,072	3,269	4
1990e	65,657	1,402	1,593	14,415	13,177	23,022	4,996	3,243	4
1989e	63,860	1,402	1,592	14,102	12,679	22,561	4,875	3,104	4
1988	62,676	1,401	1,589	13,939	12,269	22,285	4,774	3,011	4
1987	61,172	1,389	1,646	13,623	11,823	21,733	4,697	2,942	6
1986	59,750	1,399	1,703	13,169	11,402	21,381	4,631	6,058	7
1985	58,641	1,454	1,738	12,874	10,750	21,182	4,650	5,964	29
1984	59,001	1,487	1,750	12,490	9,867	21,372	4,652	6,122	29
1983	57,590	1,525	1,788	12,111	9,179	21,206	4,490	5,814	31
1982	57,638	1,606	1,780	12,052	8,705	21,435	4,734	5,780	34
1981	56,831	1,598	1,855	11,757	8,559	20,972	4,597	7,434	58
1980	55,214	1,590	1,909	11,339	8,356	20,288	4,601	7,069	61
1979	53,636	1,551	2,004	10,897	8,078	19,923	4,553	6,572	63
1978	52,714	1,573	2,095	10,442	7,729	19,732	4,572	6,507	65
1977	51,849	1,648	2,525	10,048	7,322	19,552	4,514	6,442	71
1976	50,547	1,571	2,417	9,355	7,227	19,293	4,402	6,204	78
1975	49,502	1,671	2,420	9,025	7,208	18,758	4,246	6,090	84
1974	48,995	1,824	2,401	8,923	7,138	18,451	4,233	5,930	97
1973	48,459	1,754	2,378	8,842	6,936	18,475	4,171	5,802	100
1972	46,760	1,756	2,353	8,971	6,093	17,702	3,937	5,813	137
1971	45,731	1,772	2,414	8,266	6,008	17,091	3,814	4,680	156
1970	44,725	1,736	2,490	7,798	5,781	16,811	3,811	4,799	154

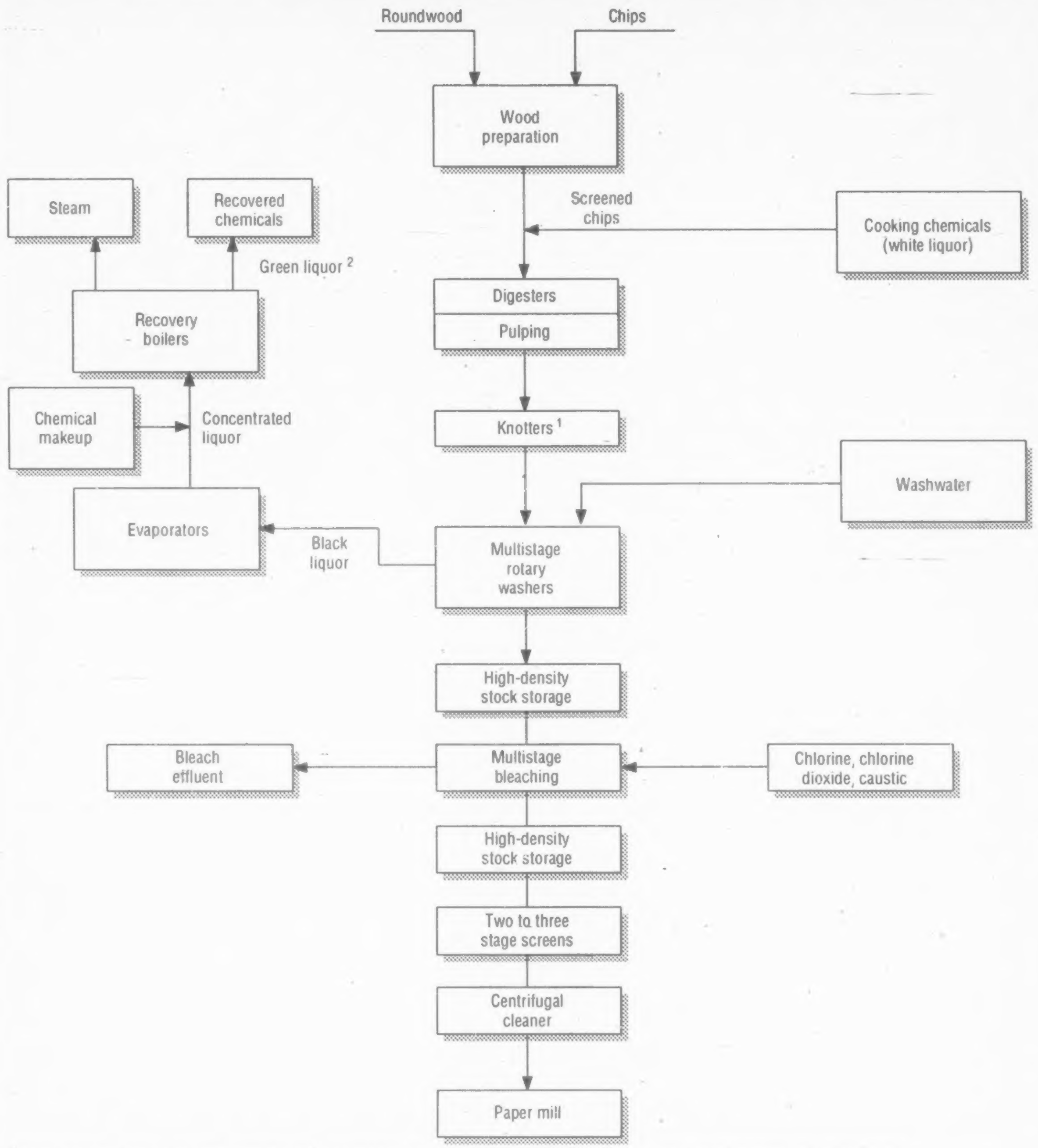
e = Estimate.

* Includes soda pulp.

1. Mainly bleached; unbleached sulfite capacity in 1983 was 400,000 tons.
2. Includes semibleached (1.5 million tons in 1977, the last year for which data were available).
3. Bleached semichemical capacity in 1983 was 361,000 tons.

Source: American Paper Institute.

SIMPLIFIED PROCESS FLOWS FOR KRAFT PULPING


Roundwood
Chips
Wood preparation
Screened chips
Cooking chemicals (white liquor)
Steam
Recovered chemicals
Green liquor [2]
Recovery boilers
Digesters
Pulping
Chemical makeup
Concentrated liquor
Knotters [1]
Washwater
Evaporators
Black liquor
Multistage rotary washers
High-density stock storage
Bleach effluent
Multistage bleaching
Chlorine, chlorine dioxide, caustic
High-density stock storage
Two to three stage screens
Centrifugal cleaner
Paper mill

[1] Some kraft mills use a hot stock refining before washing. These systems use a refiner to defibrate the unbleached pulp after pulping. The defibrated pulp is then screened before washing.

[2] Green liquor from recovery is treated in the causticizing process to process white liquor.

tive to an existing mill that is fully utilizing its recovery system because the mill would have to install additional boilers and evaporators. Another way to reduce chlorine usage is through improved brownstock washing, which reduces carryover of dissolved organic solids into the bleach plant. Also effective is the replacement of chlorine with chlorine dioxide in the chlorination stage of bleaching.

SULFITE PROCESS

Acid sulfite pulping is the oldest chemical pulping process used in North America, but its use has been declining. While U.S. and Canadian kraft pulp capacity more than quadrupled from 1950 to 1987, sulfite capacity remained almost flat during this period. In 1989, production at 45 mills totaled 3.25 million metric tons. Of this amount, about 1.4 million tons were produced in the U.S. and 1.8 million tons were produced in Canada.

The sulfite process uses a solution of sulfurous acid and bisulfite salts at high temperatures to dissolve the binding lignins holding fibers together. Pulping is done in large batch digesters for six to nine hours, depending on pulp quality. A wide range of yields can be produced by the sulfite process. High-yield sulfite (typically called bisulfite pulp) is used for newsprint and has yields of about 55%. Chemical-grade acid sulfite pulp has much lower yields in the range of 45%.

Several different chemical bases are used to produce sulfite pulps. Originally, the sulfite pulping process used a calcium base; however, recovery of spent liquors was difficult and uneconomical. Today, sulfite processes are based not only on calcium but also on ammonia, sodium, and magnesium. The sodium- and magnesium-based processes offer full chemical recovery. In the ammonia-based process, liquor is burned for energy, but its ammonia or nitrogen values are not necessarily recovered. However, sulfur dioxide from this process can be recovered.

Chemical-grade sulfite pulps are used to make fine papers, tissue papers, bristols, and other high-quality papers. But sulfite pulps produced from either softwoods or hardwoods have poorer strength properties than equivalent sulfate pulps. This has prevented their use in areas where high strength is required (e.g., linerboard, bag and sack).

SEMICHEMICAL PULPING

Semichemical pulping was developed in the late 1920s at the Forest Products Research Laboratory in Madison, Wis. It was intended for the pulping of hardwoods, which at that time were not extensively used for pulp fiber. The process involves a mild chemical pulping of chips prior to mechanical defibrating. Semichemical pulp has an intermediate strength level and a fairly high yield—60% to 80%. Although the process is used mainly for pulping hardwood

U.S. CONSUMPTION OF FIBROUS MATERIALS IN PULP, PAPER, AND BOARD MANUFACTURE[1]

(000 short tons)

			Wastepaper						
Year	Total woodpulp[1]	Total wastepaper[2]	Mixed	News	Corrugated	High-grade pulp substitutes	High-grade deinking	Other[3]	Cotton linter pulp
1988	62,647	17,181	2,422	3,185	8,665	1,323	1,585	275	146
1987	61,231	16,618	2,169	3,143	8,345	1,433	1,529	273	105
1986	59,882	15,419	2,115	3,140	7,502	1,253	1,409	288	111
1985	56,639	14,818	2,081	3,031	7,234	1,111	1,360	301	95
1984	50,309	14,944	2,136	3,018	7,231	1,248	1,310	346	92
1983	53,970	14,170	2,059	2,783	6,846	1,262	1,220	334	79
1982	50,186	13,563	1,980	2,790	6,486	1,237	1,148	331	65
1981	52,779	12,872	2,165	2,417	5,919	1,380	991	451	58
1980	51,804	12,583	2,686	2,116	5,628	1,302	851	556	49
1979	51,557	13,012	2,889	2,131	5,737	1,401	854	681	47
1978	49,694	12,481	3,149	3,149	5,187	1,338	786	779	46
1977	49,132	12,103	3,001	3,001	4,839	1,403	784	785	40
1976	47,541	11,874	3,009	3,009	4,618	1,323	771	700	42
1975	42,431	10,367	2,761	2,761	3,950	1,142	650	587	37
1974	48,341	12,098	3,332	3,332	4,669	1,427	615	792	37
1970	43,192	10,594	3,393	3,140	3,511	1,377	493	780	46

1. Woodpulp is also consumed in many nonpaper and board products, such as chemical cellulose, molded pulp products, etc.
2. Census data for wastepaper consumption are lower than those reported by American Paper Institute. See section on wastepaper.
3. Straw, rags, bagasse, etc.

Source: Bureau of the Census.

chips, it can also handle softwood chips and sawdust. Semichemical pulping of hardwood fibers provides an excellent pulp for corrugating medium.

The original semichemical process is called neutral sulfite semichemical process (NSSC). It pulps hardwood chips in a solution of sodium sulfite at an alkaline pH. Soda ash is added to buffer the acids formed during pulping. When NSSC pulping was first practiced, it was done in rotary digesters using batch techniques. With the development of digesters such as the Pandia, M&D, and Defibrator, most NSSC pulp mills adopted continuous pulping. Digesting retention time is very short in continuous pulping, typically not over 30 minutes at temperatures exceeding 170°C (338°F). The spent chemicals and organic materials are either washed or pressed from the pulp, then burned in a fluidized-bed incinerator or in specially designed units such as Tampella's recovery unit.

A nonsulfur-based semichemical process was developed in the late 1960s by Owens-Illinois Inc. This system uses a solution of sodium hydroxide and soda ash to produce a semichemical pulp equivalent in quality to NSSC pulp. It is adaptable to existing processes with only minor modifications. More than half of all NSSC pulp producers have shifted to the no-sulfur, soda-based cook.

MECHANICAL PULPING

In the mechanical process, pulpwood (roundwood or chips) is converted to pulp by mechanical energy. Mills first used the groundwood modified process, but it is no longer the most prevalent by a small margin. Short logs are fed against a rotating disc called a grinder. Fibers and bundles of fibers are ground off and then sluiced with water into a chest beneath the grinder. The high temperature

U.S. PULP MILLS—SUMMARY OF STATISTICS

	All establishments		Employees					
Year[1]	Total (number)	With 20+ employees (number)	Number (000)	Payroll (million $)	Value added by manufacture (million $)	Cost of materials (million $)	Value of shipments (million $)	New capital expenditures (million $)
1987 Census	39	38	14.2	$536.3	$2,246.0	$1,954.9	$4,213.9	$358.4
1986 ASM	n.a.	n.a.	15.3	593.7	1,590.8	2,212.7	3,837.3	874.6
1985 ASM	n.a.	n.a.	16.3	555.4	1,133.1	2,095.0	3,228.0	745.0
1984 ASM	n.a.	n.a.	16.8	549.0	1,599.4	2,267.3	3,841.1	600.4
1983 ASM	n.a.	n.a.	16.9	508.7	1,239.4	2,003.8	3,261.4	915.7
1982 Census	43	41	16.7	467.5	1,113.8	1,986.5	3,129.0	658.6
1981 ASM	n.a.	n.a.	15.9	408.1	1,221.7	1,960.1	3,141.8	521.5
1980 ASM	n.a.	n.a.	16.2	404.6	1,292.7	1,776.9	3,031.9	258.8
1979 ASM	n.a.	n.a.	15.7	338.9	1,117.2	1,417.2	2,544.1	239.7
1978 ASM	n.a.	n.a.	15.1	306.3	855.5	1,268.0	2,152.4	194.6
1977 Census	45	42	16.2	293.2	885.7	1,212.4	2,071.1	301.1
1976 ASM	n.a.	n.a.	15.7	260.5	974.6	1,087.7	2,055.4	375.0
1975 ASM	n.a.	n.a.	13.1	191.4	821.0	837.0	1,630.4	294.2
1974 ASM	n.a.	n.a.	12.0	163.2	779.3	766.1	1,525.2	135.6
1973 ASM	n.a.	n.a.	10.8	138.2	382.7	464.0	848.5	118.7
1972 Census	60	35	10.6	125.7	306.9	388.1	709.9	136.4
1971 ASM	n.a.	n.a.	14.5	156.3	367.2	496.4	841.8	135.2
1970 ASM	n.a.	n.a.	15.6	160.2	466.3	508.3	960.3	121.6
1969 ASM	n.a.	n.a.	14.9	142.6	362.0	455.2	820.0	132.6
1968 ASM	n.a.	n.a.	15.4	136.0	361.3	431.2	799.3	77.0
1967 Census	61	43	15.1	125.6	333.7	403.2	730.5	121.8
1966 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	658.5	113.3
1965 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	758.5	112.2
1964 ASM	n.a.	n.a.	15.3	113.6	331.6	328.6	662.8	66.6
1963 Census	45	40	15.1	107.4	295.8	312.6	609.1	38.9

n.a. = Not available.

[1] In years of Annual Survey of Manufactures (ASM), data are estimates based on a representative sample of establishments canvassed annually and may differ from results of a complete canvass of all establishments.

Source: *1987 Census of Manufactures.*

created by the meeting of grinder and log has a plasticizing effect on lignin, thus reducing the energy needed to loosen fibers from the wood mass. It also prevents excessive damage to the fibers, which are short and choppy but of a very high yield (+90%). These pulps are refined to remove shives and bundles and to develop strength properties.

Groundwood pulps are ideal for bulky sheets that require good opacity, such as newsprint and low-quality printing grades. Because these pulps have poor sheet strength, kraft or high-yield sulfite pulp must be added to grades such as newsprint so they can run on paper machines and printing presses. North American groundwood pulp capacity for paper and board production is about 8.2 million metric tpy.

Because grinders must accept logs, it is impractical to use chips for mechanical pulp production. In the early 1960s, mills discovered that chips could be refined, with or without preheating, in large disc refiners that discharge to the atmosphere. The resulting pulps tend to have longer fiber lengths than groundwood-prepared pulps from the same species. Consequently, they have somewhat better strength but slightly lower opacity. This process, called refiner mechanical pulping (RMP), opened the way for mills, especially in the Pacific Northwest, to use residual chips for the production of mechanical pulps. North America has about 700,000 metric tpy of RMP capacity.

In the late 1960s, mills learned that if chips were presteamed and refined under pressure in a disc refiner, a much higher quality of pulp could be obtained. This process, called thermomechanical pulping (TMP), allows mills to produce a stronger pulp than previously thought possible with mechanical processes. In a typical TMP process, softwood chips are presteamed at 110°C (230°F) for one or two minutes. Next, they are fed via a press feeder or pocket feeder into a pressurized refiner with specially designed plates, and then they are released under pressure into a stock chest. These pulps are further refined in a second stage.

Within the last decade, several modifications have been made to the TMP process. Some of these processes use chemicals (usually sodium sulfite at various pHs) before and after the TMP stage. Some involve steaming and nonpressurized first-stage refining, while others use no steaming and pressurized refining.

The most important of these variations is the chemithermomechanical pulping (CTMP) process developed in Scandinavia during the late 1970s. CTMP differs from TMP mainly in its use of equipment for chip impregnation with

CANADIAN PRODUCTION OF WOODPULP

(000 metric tons)

Year	Total all grades[1]	Dissolving and special alpha	Bleached sulfite	Unbleached sulfite	Bleached hardwood sulfate	Bleached softwood sulfate	Semibleached sulfate	Unbleached sulfate	Semichemical	Mechanical
1987	23,035	241	454	1,296	1,324	6,887	1,169	1,474	353	9,820
1986	21,712	223	428	1,248	1,299	6,324	1,188	1,410	321	9,252
1985	20,417	222	329	1,269	1,174	5,873	1,170	1,383	258	8,722
1984	20,346	221	365	1,405	1,214	5,568	1,065	1,469	331	8,690
1983	19,376	216	304	1,353	1,050	5,693	1,019	1,486	306	7,934
1982	17,164	219	280	1,446	817	5,098	916	1,235	255	6,879
1981	19,326	274	430	1,819	812	5,449	1,057	1,497	322	7,647
1980	19,985	313	405	1,763	832	5,922	1,185	1,689	333	7,521
1979	20,331	311	478	1,806	811	5,471	1,038	2,061	354	7,956
1978	19,783	341	516	1,787	785	5,086	1,054	1,942	318	7,910
1977	17,925	230	636	1,621	680	4,620	1,039	1,574	263	7,226
1976	17,687	222	609	1,649	594	4,672	1,038	1,559	269	7,037
1975	14,850	226	516	1,442	452	3,767	863	1,314	233	6,007
1974	19,359	333	734	1,865	777	4,632	1,096	1,942	329	7,588
1973	18,218	293	507	1,750	893	4,155	1,097	1,922	350	7,196
1972	17,123	370	526	1,711	835	3,556	1,127	1,639	337	6,967
1971	16,235	388	587	1,706	723	3,130	1,150	1,467	301	6,718
1970	16,350	411	684	1,870	3,660[2]		1,084	1,341	285	6,940
1965	13,050	431	817	1,836	1,862		566	1,114	177	6,170
1960	10,255	356	519	1,560	1,062		257	895	203	5,335
1955	9,082	265	566	1,625	663		55	617	141	4,960
1950	7,606	305	386	1,315	396		12	548	94	4,445

1. Excludes defibrated and exploded pulp (51,000 tons in 1986) used mainly in construction grades; about 45,000 tons of screenings are included.
2. Total bleached softwood and hardwood production.

Source: *Statistics Canada.*

chemicals prior to refining. The process usually begins with an impregnation of 2% to 5% of sodium sulfite and chelating agents with a pH of 9 to 12. Next comes preheating for 2 to 5 minutes at 120° to 130°C, followed by refining. For softwood, the unbleached yield is 92% to 96%, depending on the raw material and amount of chemicals used. With peroxide bleaching, a brightness level of about 80 to 82 ISO can be reached for softwood CTMP. For hardwood, brightness can go as high as 87—almost equal to bleached kraft pulp.

Chemical pretreatment of chips gives CTMP the following advantages over TMP: (1) less destructive separation of fibers from the wood, resulting in a higher, longer fiber content and a much lower shive content; (2) more flexible fiber, which is reflected in higher sheet density and higher burst and tensile strength; (3) higher brightness level before bleaching; (4) more efficient removal of wood extractives, which makes CTMP better suited for absorbent grades and food packaging.

Compared with chemical pulp, bleached softwood kraft has higher tensile strength, while CTMP has better opacity. Tear strength is about the same for both grades. The most serious drawback of mechanical pulps is color reversion.

Most TMP and CTMP are now being used in newsprint, uncoated groundwood, and coated publication papers. These pulps permit newsprint mills to reduce or even eliminate chemical pulp content in their furnishes. High-freeness, mainly softwood CTMP is also being used in absorbent products (towels and baby diapers) and in bleached board. Several new Canadian market pulp mills are marketing low-freeness, aspen CTMP grades for use in coated and uncoated free-sheet grades. Some of these mills have two lines to produce both high- and low-freeness pulp. This permits fines from the high-freeness line to be transferred to the low-freeness line. Likewise, long fibers from the latter may be moved to the high-freeness line.

As the fastest-growing pulping processes, TMP/CTMP are now more predominant than groundwood in mechanical pulping. North America currently has about 8.8 million metric tpy of TMP/CTMP capacity, and growth is expected to continue. One drawback of TMP/CTMP is its high energy requirement. Methods such as pressurized cyclone are being developed to improve the recovery of steam, which can be used in drying pulp or paper.

Despite the waning popularity of groundwood pulping, Tampella Oy of Finland and MoDoCell of Sweden introduced a new innovation in the late 1970s—pressurized groundwood (PGW) pulping. PGW differs from conventional grinding because the grinding occers under pressure that permits shower water to be heated to higher temperatures

CANADIAN WOODPULP CAPACITY

(000 metric tons)

Year	Total* all grades	Dissolving and special alpha	Bleached sulfite	Un-bleached sulfite	Bleached softwood sulfate	Semi-bleached softwood sulfate	Bleached hardwood sulfate	Un-bleached sulfate	Semi-chemical	Mechanical
1991e	28,394	252	481	1,260	7,935	965	2,170	1,561	513	13,257
1990e	27,196	252	481	1,290	7,729	968	1,916	1,561	513	12,486
1989e	26,030	273	460	1,393	7,463	943	1,692	1,562	490	11,754
1988	25,021	277	452	1,399	7,410	962	1,595	1,561	465	10,900
1987	24,740	245	466	1,446	7,201	1,082	1,367	1,543	465	10,445
1986	24,509	245	582	1,438	7,023	1,123	1,279	1,682	456	10,201
1985	23,423	266	572	1,414	6,804	1,085	1,253	1,719	449	9,861
1984	23,305	264	371	1,634	6,578	1,127	1,311	1,735	472	9,813
1983	22,889	267	391	1,734	6,492	1,169	1,121	1,734	462	9,519
1982	22,618	305	436	1,950	6,336	1,236	988	1,759	445	9,163
1981	22,424	303	461	2,119	6,371	1,106	955	1,788	445	8,876
1980	21,864	307	426	2,062	6,252	1,198	879	1,752	438	8,550
1979	22,521	395	512	2,100	6,114	1,258	866	1,807	459	9,010
1978	22,014	424	580	2,091	5,699	1,216	852	1,824	455	8,837
1977	22,251	353	727	2,119	5,535	1,191	848	2,062	454	8,924
1976	22,242	408	807	2,134	5,329	1,189	860	2,157	426	8,894
1975	21,960	427	794	2,131	5,256	1,203	877	2,132	400	8,696
1974	21,641	404	689	2,144	5,027	1,264	867	2,087	390	8,716
1973	20,957	416	622	2,107	4,651	1,249	844	1,967	392	8,652

e = Estimate.

* Includes screenings; excludes mechanical pulp for paper and board.

Source: Canadian Pulp & Paper Assn.

(over 95°C). The higher temperatures soften the lignin and permit woodfiber to be released with less damage.

Pulp produced by this process has strength values approaching those of TMP, with only two-thirds the power consumption, or about the same amount of power required by conventional groundwood. PGW is used at over 17 mills in Europe, North America, and Japan, and it represents about 2 million metric tpy of capacity. In North America, Madison Paper Co. and Lake Superior Paper Industries use the process to produce supercalendered paper, while Blandin Paper Co. and James River Corp. (St. Francisville, La.) use it to make lightweight coated paper.

DEFIBRATED PULP PROCESS

The defibrated pulp process is the simplest way of preparing pulp, and it gives the highest yield with less pollution, but defibrated pulp has very poor strength characteristics. It can be prepared from either softwoods or hardwoods, depending on the product and the availability of timber. Defibrated pulp was first prepared by the Masonite process, which steams chips under pressure in a vessel and releases them via a gun or nozzle to atmospheric pressure. The explosion literally blows the pulp into individual fiber masses, which are mixed to make a pulp slurry. This slurry can make coarse grades of paper and board with little or no extra refining. It is ideally suited for making insulation and hardpressed board.

THERMOMECHANICAL PULPING CAPACITY TRENDS IN U.S. AND CANADA

(000 metric tons)

Year	Canada*	U.S.	Total
1991e	8,034	3,328	11,362
1990e	7,190	3,149	10,339
1989e	5,986	2,909	8,895
1988	5,062	2,783	7,845
1987	4,375	2,691	7,066
1986	4,122	2,413	6,535
1985	3,811	2,267	6,078
1984	3,563	2,225	5,788
1983	3,135	1,985	5,120
1982	2,383	1,858	4,241
1981	1,738	1,563	3,301
1980	1,115	1,244	2,359
1979	717	791	1,508
1978	544	652	1,196
1977	533	514	1,047
1976	380	302	682
1975	69	119	187

Note: Table figures changed to metric tons for this edition.
* = Includes chemi-thermomechanical pulp.
e = Estimate.

Sources: Canadian Pulp & Paper Assn., American Paper Institute.

In the late 1930s, Defibrator AB of Sweden developed the defibrated pulping process. In this process, pulp is fed continuously to a presteaming vessel under slight pressure and reasonably high temperature, then discharged through a pressurized refiner at the bottom or end of the pulping vessel, where it is defibrated under pressure. Next, the pulp is discharged to atmospheric pressure to either a live-bottom storage bin or to a stock chest, where it is diluted to make a stock slurry. If necessary, the pulp is again refined, mainly to break up fiber bundles and to develop strength characteristics. It is then fed to either a cylinder- or fourdrinier-type former.

If the fiber from this process is to be used in a dry process such as hardpressed board production, it is not diluted with water. Instead, it is stored in a live-bottom bin and then fed through a distributor line onto a forming wire. The capacity for making defibrated pulp has grown rapidly during the last 20 years.

DEINKING PROCESS

Deinking is the process of removing inks—and in some cases, coating and filler—from wastepapers that are primarily newspaper and coated ledgers.

Deinking is mostly done at nonintegrated paper mills in two processes: flotation and washing. In the washing system, wastepaper is pulped with chemicals (soda ash, caustic soda, sodium silicates, surfactants, or solvents) in an open pulper either on a continuous or batch basis. The pulp is washed free of ink on conventional rotary washers or on side-hill screens. The washed pulp is then screened and bleached.

Flotation deinking uses air to float off ink particles from the fibers. The wastepaper is first sent to a pulper with deinking chemicals, cleaned with screens and centrifugal cleaners, and then deinked with flotation cells. Chemicals typically used are sodium peroxide, silicates, foamers (soaps), and a collector.

In addition to the two main systems—flotation and washing—several other deinking systems are used. Three combination processes have a washing system coupled with a flotation unit to clean effluent from the washers. Regardless of the type of system, the pulper is usually run batch, while the deinking line draws from a storage tank and is run continuously. However, some systems take pulp out of the pulper continuously and run the deinking line continuously as well.

Over 50 mills in North America deink wastepaper. More than 45 of them are in the U.S., and about six are in Canada. Tissue mills (approximately 20 installations) account for nearly half of all deinking mills. Fort Howard Corp. is a leader in deinked tissue production, using proprietary technology to process less expensive wastepaper grades. Deinked fibers are used by twelve mills for printing/writing grades, by four mills for linerboard and boxboard, and by seven mills for newsprint. Garden State Paper Co. is the leading U.S. producer of recycled newsprint. Several small U.S. mills owned by Ponderosa Fibres of America produce deinked market pulp.

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight, bl/unbl (%)	Strength of pulp[1]	Pulp usage	Final products	U.S. capacity 1988 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Dissolving	Prehydrolyzed kraft	Woodchips first receive an acid or water hydrolysis to remove pentosans and then are pulped via kraft process. Very high alpha grades receive a cold caustic treatment after kraft pulping.	Softwoods: southern pine. Hardwoods: gum, oak, southern mixed hardwoods.	30-35	Low	Chemically converted into chemicals, plastics, rayon, cellophane, or acetates.		800e	3
	Sulfite	Woodchips first are pulped under special acid sulfite pulping conditions. Higher purity achieved via pressure heat treatment or cold caustic treatment stages.	Softwoods: southern pine, hemlock, spruce. Hardwoods: eastern.	30-35	Low	Same as above.		600e	5
Chemical	Kraft	Woodchips reduced under steam pressure to pulp with alkaline chemicals (sodium hydroxide and sodium sulfide).	Softwoods	42-55	Softwoods: high to very high. Hardwoods: medium to medium high.	Higher yield pulp used for containerboard. Lower yield pulp used for numerous grades of paper. Often mixed with other pulps.	Strong wrapping and bag paper, containerboard, book, newsprint, highest grade magazine and other printing papers, bond, writing	Total: 49,342 Bleached and semi-bleached softwood: 14,102 Hardwood: 12,679	124
			Hardwoods	44-49					
	Sulfite	Woodchips reduced under steam pressure to pulp with an acid chemical (calcium, magnesium, sodium, or ammonium bisulfite plus sulfurous acid).	Softwoods: spruce, balsam, hemlock, southern pine. Hardwoods: eastern lake.	44-49	Softwoods medium to high.	Usually mixed with other pulps. When purified, used for cellulose products.	Book and magazine, wrapping, tissue, newsprint, glassine, writing, cellulose	1,407	18

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight, bl/unbl (%)	Strength of pulp[1]	Pulp usage	Final products	U.S. capacity 1988 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Chemical (cont.)	Soda	Woodchips reduced under steam pressure to pulp with an alkaline chemical (caustic soda).	Mostly hardwoods: aspen, cottonwood, basswood, beech, birch, maple, oak, tupelo (gum)	40-48	Medium to medium low	Often mixed with sulfite and other pulps.	Book and magazine, lithograph, other printing papers, envelope, blotting paper	312e	2
Semi-chemical	Neutral sulfite, bisulfite, acid sulfite, kraft, soda, or caustic	Woodchips partially softened under steam pressure with chemicals are reduced to pulp by mechanical action.	Hardwoods: same as for soda pulp. Red alder. Often pulped in mixtures. Softwoods: small amounts of Douglas fir, ponderosa pine, and sugar pine.	60-80	Medium to medium low	Alone in corrugating and some other boards. Bleached pulps mixed with softwood pulps for other products.	Corrugating board, food and other specialty boards, glassine magazine, newsprint, insulating and sheathing board	4,875	36
Chemi-mechanical	Mason (exploded) Asplund (defibrated)	Woodchips treated with steam or hot water at high temperatures and pressures to soften the wood, followed by mechanical fiberization.	Softwoods and hardwoods	80-95	Low to very low	Coarse pulps composed of mixture of single fibers and fiber bundles used alone and mixed with other pulps.	Hardboard, insulating, roofing and linoleum felts	600e	25e
	Cold soda	Woodchips given mild treatment with sodium hydroxide solutions and then mechanically fiberized to pulp.	Hardwoods: birch, maple, beech, oak, sweetgums, aspen. Bagasse. Often pulped in mixtures.	80-95	Medium to low	Often mixed with other pulps.	Printing paper	200e	4e

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight, bl/unbl (%)	Strength of pulp[1]	Pulp usage	Final products	U.S. capacity 1988 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Mechanical	Groundwood (GWP)	Wood bolts reduced to pulp by pressing on a revolving grindstone.	Softwoods: spruce, balsam, pine, hemlock. Hardwoods: aspen, cottonwood.	93-93	Low	Usually mixed with chemical pulp.	Newsprint, magazine, book, catalog, tissue/towel, boxboard, building, insulating board	3,104	71
	Refiner mechanical (RMP)	Woodchips are mechanically fiberized in non-pressurized disc refiners.	Same as GWP	93-93	Low but higher than GWP	Blended with GWP or chemical.	Newsprint	335	7
	Thermo-mechanical (TMP)	Woodchips are first presteamed and fiberized in pressurized disc refiners.	Same as GWP	90	Low but higher than RMP	Same as above.	Newsprint, publication papers, fiberboard	3,207	23e
	Chemi-thermo-mechanical (CTMP)	Woodchips are impregnated with 2% to 5% sodium sulfite prior to refining; otherwise, similar to TMP.		90-95	Higher than TMP but lower than kraft	Same as above.	Newsprint, publication papers, tissue/towel, bleached board, fluff	30 (2,500e in Canada)	1 (15+ in Canada)
	Pressurized groundwood (PGW)	Groundwood made by grinding logs in a pressurized atmosphere with grinder at high temperature.	Same as GWP	90-93	Nearly as high as TMP; higher than groundwood	Same as GWP.	Supercalendered papers, coated groundwood	510	4

1. A very general rating based on the full range of pulp strengths.
2. Except for kraft, sulfite, and chemi-thermomechanical pulp, nearly every kind of pulp mill must be integrated with a paper or board mill, with excess production being offered for sale.
n.a. = Not available.
e = Estimate.

Source: Updated by *Pulp & Paper* from A.D. Little Inc. report for EPA, Environmental Considerations . . ., Vol. V, Pulp & Paper Industry Report, 1976.

DESCRIPTIONS OF MECHANICAL PULPING PROCESSES

Groundwood pulp (GW). Groundwood produced by atmospheric grinding of logs with conventional stone grinder.

Pressurized groundwood (PGW). Groundwood produced by grinding logs in a pressurized atmosphere with a conventional grinder.

Groundwood from chips (FGP). Groundwood produced by atmospheric grinding of chips with a modified grinder. There is no common abbreviation: the FGP is used by the Japanese inventors—F for fine, and GP for groundwood pulp.

Refiner mechanical pulp (RMP). Atmospheric refining of untreated chips.

Chemirefiner mechanical pulp (CRMP). Atmospheric refining of chemically treated chips.

Chemi-thermomechanical pulp (CTMP). Produced from chips pretreated with chemicals prior to steaming, then refined in pressurized refiner, with or without subsequent pressurized or atmospheric refining stages.

Thermomechanical pulp (TMP). Produced from chips first presteamed and refined in one or more stages of pressurized refining, or followed by atmospheric refining.

Sodium-sulfite-treated TMP (Opco TMP). Process developed by Ontario Paper Co. that involves treating (cooking) TMP pulp (rather than chips before refining) with sodium sulfite.

Sulfonated chip mechanical pulping (SCMP). Patented process of CIP Inc. that is basically chemical pretreatment of chips followed by atmospheric refining. (Abitibi-Price and Stone-Consolidated both have variations of this process; S-C refers to its process as "Ultra High Yield [UHY]," but this process might be called sulfite pulp or CRMP.)

Tandem TMP. Refers to an arrangement of refiners. For example, single stage only (pressurized); two stages (first only pressurized); three stages (only first pressurized).

Riverside Paper Co. has a unique solvent-extraction system that is used on wastepaper such as cupstock, milk carton stock, and other difficult-to-clean waste.

NEW PULPING PROCESSES

Interest is growing in the use of organic solvents, such as ethanol and methanol, to remove lignin. The concept of organosolv pulping was first proposed in the early 1930s, but such processes have only recently come close to commercial development.

With assistance from the Canadian federal government in early 1989, Repap Enterprises Inc. started up a 33-tpd demonstration plant for its Alcell process at Miramichi, N.B. The process uses ethanol and water to dissolve lignin from hardwood chips in an extractor under controlled temperatures and pressures. The lignin separation and liquor recovery system then separates byproducts (sulfur-free lignin and wood sugars) and recycles the ethanol back to the extraction stage. Repap is considering the feasibility of scaling up the process to a 250-tpd commercial facility.

Another variation of the process has been developed in Fed. Rep. Germany, where a 5-tpd demonstration plant has been operating for several years. The MD Organocell process uses methanol and can be used to pulp softwood chips. An 85-tpd system using this process is being installed at an existing paper mill. Advantages of organosolv pulping include lower capital costs, feasibility of smaller-size "minimills," minimal environmental impact due to the absence of chlorine, and production of potentially valuable byproducts. The process, however, requires complex pulp-washing arrangements. Volatile pulping chemicals are also used, which can lead to explosions or fires, and the process may not work well on mixed wood species, according to some independent researchers.

The use of anthraquinone (AQ) as a catalyst in kraft and soda pulping has been developed by Canadian Industries Ltd. of Montreal. Mill trials have shown that this organic chemical, when applied in a ratio of about 0.10% to 0.15% to softwood during kraft pulping, typically improves yield by 2% to 3%. It also reduces alkali consumption by 10% to 15% and shortens cooking time. AQ apparently speeds up the removal of lignin, allowing the pulp to retain more hemicellulose.

Fiber:

MARKET PULP

More than three-quarters of the world's woodpulp never leaves the mill in which it is produced; instead, it is used in another part of the facility to make paper and paperboard. In some cases, however, a paper mill may not produce a certain type of pulp, or it may be a "nonintegrated" facility with no pulping capacity of its own. As a result, the paper mill will fill its requirements from other mills in its own corporate network, or it will purchase pulp from outside "market pulp" suppliers.

Market pulp is defined as woodpulp produced for sale in open competition with pulp from other producers. It excludes tonnage that is consumed by the producing mill or shipped to any of its affiliated mills within the supply region. With one exception, all pulp exported from supplying countries, including pulp shipped to affiliated enterprises in other countries, is considered market pulp. The exception is the substantial volume of pulp produced in Canada for delivery to affiliated companies in the U.S. These deliveries, amounting to about 1.2 million metric tons in 1988, are considered "tied" pulp and are not included in market pulp statistics.

Market pulp is divided into two basic groups: (1) dissolving or special alpha pulps and (2) paper-grade pulps. Dissolving and special alpha pulps have a high alpha (pure cellulose) content and are used to make rayon, acetate, and other cellulose derivatives as well as specialty papers. Most paper-grade market pulps are produced by chemical processes, although some are made by mechanical methods such as stone groundwood, thermomechanical (TMP), and chemi-thermomechanical (CTMP) pulping.

Chemical paper-grade pulps produced in North America can be further divided according to pulping process (sulfate/kraft or sulfite), basic wood type (softwood or hardwood), production region (northern or southern), and brightness level (bleached, semibleached, or unbleached). The four most important grades of chemical paper-grade pulp are (in descending order of quality, as measured in terms of price) bleached northern and southern softwood and bleached northern and southern hardwood. Fluff pulp (mainly bleached softwood kraft) goes into nonpaper applications, such as baby diapers, but it is included in paper-grade pulp for statistical purposes.

Most paper-grade market pulp is cut into sheets and sold in bale form, but some is sold in rolls, and a small amount is flash-dried and baled. Integrated paper mills can sell captive pulp on the open market when internal pulp demand is low. When pulp demand is high, these integrated mills may become net pulp buyers or may shift tonnage to affiliated paper mills. Dissolving pulp mills produce either chemical cellulose or paper-grade pulps. As a result, market pulp capacity ratings are inexact and vary with market conditions.

STATISTICS FOR MARKET PULP

(000 metric tons)

	1989e	1988	1987
U.S.			
Production	6,730	6,530	6,175
Capacity[1]	6,826	6,769	6,444
Utilization rate, %	98.6	96.5	95.8
Apparent consumption	5,540	5,490	5,205
Imports	2,910	2,836	2,700
Exports	4,100	3,876	3,670
CANADA			
Production	7,220	7,225	7,200
Capacity[1]	7,429	7,390	7,335
Utilization rate, %	97.2	97.8	98.2

e = Estimate.

[1] Based on 1988 American Paper Institute and 1989 Canadian Pulp & Paper Assn. capacity surveys.

CHEMICAL PAPER-GRADE MARKET PULP

Bleached sulfate (kraft) is the predominant grade of market pulp, with Canadian and U.S. production in 1988 totaling 12.8 million metric tons (including semibleached pulp). The largest percentage of production is made from softwood fibers such as spruce, fir, and pine. **Bleached softwood kraft** output totaled 5.9 million tons in Canada and 3.6 million tons in the U.S. in 1988. The most preferred softwood pulps generally are those from mills in western and eastern Canada, the northeastern U.S., and to a lesser extent the U.S. Pacific Northwest (where some mills use less desirable species such as pine and redwood).

Southern U.S. pine pulps are somewhat lower in quality, as the fiber is coarser and produces a poorer sheet for printing/writing grades. With increasing availability, however, papermakers have learned how to use larger percentages of southern pine pulp in most white paper grades. Nevertheless, southern pine pulps normally sell at about a $25 to $30/metric ton discount from premium northern bleached softwood kraft (NBSK) pulp. In weak markets, the differential may be larger.

Bleached hardwood kraft market pulps are produced in the U.S. Northeast and South, with a small amount also produced in eastern Canada. Hardwood accounts for about 41% of U.S. and 13% of Canadian bleached sulfate market pulp production. Canadian and U.S. hardwood normally sells at about a $10/metric ton premium to southern U.S. hardwood. Southern hardwood pulps are usually sold as mixed hardwoods, which may include oak. Oak and other species high in vessels cause excess picking on offset printing grades, although papermakers have reduced the picking tendency so that problems are not too serious for printers.

Hardwood pulps, blended with or without softwood pulps, make an excellent printing/writing grade, providing bulk and a good printing surface. Hardwood kraft market pulps are generally sold at a $20 to $25/ton discount from softwood kraft grades produced in the same region.

A newer type of hardwood pulp not produced domestically but increasingly popular in North America and around the world is bleached **eucalyptus kraft** pulp. About 15% of U.S. hardwood pulp consumption now consists of eucalyptus pulp from Brazil, with another 1% to 2% from Spain and Portugal. Since breaking into the world pulp scene

U.S. PRODUCTION OF MARKET WOODPULP

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Sulfite	Total bleached and semi-bleached sulfate*	Bleached and semibleached softwood sulfate	Bleached and semibleached hardwood sulfate	Un-bleached sulfate
1988	7,673	1,238	249	6,022	3,555	2,467	164
1987	7,373	1,187	222	5,799	3,428	2,357	166
1986	6,849	1,138	204	5,385	3,295	2,090	140
1985	6,156	1,063	202	4,756	3,075	1,681	135
1984	6,245	1,093	238	4,775	3,035	1,740	139
1983	5,911	1,145	208	4,430	2,752	1,678	128
1982	5,200	986	187	3,914	2,558	1,356	111
1981	5,626	1,224	241	4,030	2,559	1,471	131
1980	5,865	1,366	345	3,971	2,480	1,491	119
1979	5,151	1,360	250	3,381	2,084	1,298	102
1978	4,647	1,273	227	2,985	1,785	1,200	88
1977	4,358	1,327	211	2,626	1,673	953	124
1976	4,413	1,243	287	2,721	1,659	1,062	102
1975	3,953	1,118	292	2,423	1,777[1]	891[1]	79
1974	4,663	1,461	360	2,635	1,428[1]	1,093[1]	173
1973	4,468	1,356	441	2,552	1,384[1]	1,040[1]	100
1972	4,559	1,519	436	2,454	1,300[1]	1,023[1]	106
1071	4,204	1,524	378	2,109	1,096[1]	842[1]	200
1970	4,491	1,555	534	2,487	1,190[1]	1,075[1]	386
1965	3,486	1,347	563	1,298	n.a.	n.a.	214
1960	2,717	1,019	526	897	n.a.	n.a.	262
1955	2,429	880	551	767	n.a.	n.a.	204
1950	1,454	428	604	261	n.a.	n.a.	113

* = Includes soda pulp.
n.a. = Not available.
1. Excludes semibleached.

Source: American Paper Institute.

about a decade ago, eucalyptus shipments have grown from 434,000 tons in 1976 to about three million tons currently. Originally, its popularity was due to lower costs combined with desirable performance features ranging from opacity in printing/writing papers to softness in tissue. As a result, eucalyptus has become a preferred pulp, selling at a price at least equal to the best northern hardwood grades in Europe and the U.S.

Of the estimated 3.2 million tons of bleached eucalyptus market pulp capacity in the world in 1988, about 38% was held by Brazil, 30% by Spain, 25% by Portugal, 4.6% by South Africa, and 2.5% by Morocco. Eucalyptus can be grown rapidly on plantations. The time required for a eucalyptus plantation to reach maturity in Brazil is about seven years, compared with roughly 20 years for southern U.S. loblolly pine and perhaps 80 years or more for Canadian spruce and fir. According to Ronald J. Slinn, vice president, Pulp Materials & Technology Group of the American Paper Institute, eucalyptus plantations in Brazil will produce more than 40 m^3/hectare annually—about 20 times the growth rate of the average Canadian forest and almost three times that of a U.S. southern forest. Productivity in Spain and Portugal is somewhat lower than in Brazil, but still higher than in the southern U.S.

North American market **sulfite** pulp production in 1950 exceeded sulfate production, and for many years sulfite pulps were considered the most desirable type for papermaking. But by 1988, production of bleached and unbleached sulfite market pulp dropped to only 560,000 metric tons, accounting for only about 4% of total North American chemical paper-grade market pulp production. This trend is expected to continue with the shutdown of small, older mills and little new construction of sulfite pulp mills. (One exception was Fraser Inc.'s recent expansion at its Atholville, N.B., sulfite mill.) The same declining trend has developed in the Nordic countries, where sulfite currently accounts for about 9% of chemical paper-grade market pulp capacity.

Most North American sulfite pulp is produced from northern and eastern softwoods (spruce, pine, fir, and hemlock). ITT Rayonier Inc. at Fernandina Beach, Fla., produces paper-grade and dissolving pulp grades from southern pine. A few U.S. and Canadian mills produce sulfite pulp from hardwoods. Sulfite pulps are still highly desirable for producing high-quality tissue and printing/writing papers.

Unbleached kraft market pulp production has declined in North America. Total 1988 production of 355,000 tons accounted for only about 2% to 3% of North American

U.S. MARKET WOODPULP CAPACITY

(000 metric tons)

Year	Total all grades	Dissolving	Chemical paper grades	Bleached softwood sulfate[1]	Bleached hardwood sulfate[1]	Unbleached sulfate	Sulfite	Others
1991e	8,530	1,272	7,247	4,091	2,733	163	258	13
1990e	8,335	1,272	7,051	3,899	2,730	163	258	13
1989e	8,110	1,272	6,826	3,758	2,644	163	258	13
1988	8,054	1,271	6,769	3,734	2,610	166	258	13
1987	7,716	1,259	6,444	3,646	2,388	152	257	13
1986	7,293	1,266	6,015	3,398	2,224	132	260	13
1985	7,247	1,312	5,923	3,386	2,133	131	274	13
1984	6,831	1,349	5,469	5,063		132	274	13
1983	6,726	1,378	5,335	4,874		142	319	13
1982	6,422	1,450	4,986	4,572		129	261	11
1981	6,325	1,432	4,876	4,416		151	309	15
1980	6,170	1,430	4,653	4,163		156	335	87
1979	5,746	1,407	4,247	3,836		94	318	92
1978	5,213	1,427	3,691	3,314		97	280	94
1977	4,960	1,461	3,498	2,975		149	273	101
1976	4,905	1,289	3,616	2,896		198	416	105
1975	4,910	1,350	3,560	2,919		192	417	31
1974	5,041	1,484	3,557	2,940		173	427	17
1973	4,867	1,442	3,425	2,814		134	458	18
1972	4,910	1,560	3,349	2,774		124	451	—
1971[2]	4,498	1,597	2,901	2,251		218	432	—

e = Estimate.

1. Includes semibleached.

2. First year in which market pulp capacity was reported by API.

Source: American Paper Institute.

chemical paper-grade market pulp production. About 40% of unbleached kraft market pulp in the U.S. is used in one-time carbonizing tissue, a market that is shrinking due to inroads by carbonless copy paper. Other end uses for unbleached kraft market pulp are filter papers, cable wrap, condenser papers, twisting grades, and other specialties.

NORTH AMERICAN INDUSTRY STRUCTURE

The U.S. pulp and paper industry is highly integrated, and market pulp accounts for only a small percentage of total woodpulp production or consumption. Of the 76 U.S. companies that produce paper-grade pulp, only 29 sold any pulp in 1988, according to API. Many of the 213 companies in the U.S. paper industry also buy significant quantities of pulp, but at least 139 of these must purchase all of the fiber they require, including wastepaper.

In 1988, the U.S. paper industry produced 54.3 million metric tons of chemical paper-grade pulp, of which 84% was consumed on site, 4% was shipped to affiliated mills within the U.S., 5% was shipped to the domestic market, and 7% was exported, according to API. Apparent U.S. paper-grade woodpulp consumption in 1988 totaled 54.6 million tons, of which 83% was supplied by integrated sources within the U.S., 4% by U.S. affiliates, 5% by the domestic market, and 8% by imports.

U.S. paper pulp imports in 1988 totaled 4.1 million tons, of which 89% was supplied by Canadian producers. The remaining 11% came from Brazil, the Nordic countries, Chile, Iberia, and Swaziland.

In 1988, Canadian paper-grade pulp shipments to the U.S. were approximately 3.7 million metric tons, of which 32% was tied shipments from Canadian affiliates of U.S. paper companies.

In contrast with the U.S., market pulp accounts for a large share of total Canadian chemical paper-grade woodpulp production—about 12.6 million metric tons in 1988. Of this amount, 34% was consumed on site or by affiliated mills, 7% was shipped as market pulp to domestic mills, 27% was shipped to the U.S. (including roughly 1.2 million tons of "tied pulp"), and 32% was exported abroad, according to Canadian Pulp & Paper Assn. data. About 30 companies in Canada sell chemical paper-grade market pulp.

Paper-grade market pulp is used principally for three paper grades in the U.S.: (1) uncoated free-sheet, (2) coated printing and publication papers, and (3) tissue. The remainder is used in grades such as packaging and industrial converting papers, bristols, and bleached board.

As a result, U.S. demand for market pulp is closely related to the level of U.S. paper production, particularly of printing/writing grades. In recent years, when U.S. printing/writing paper mill operating rates exceeded the low-90% range, the amount of white market pulp consumed in relation to total white pulp usually rose above 20%. If operating rates are below 90%, however, the ratio of market to total paper pulp consumption often drops into the 18%-to-19% range. (White pulp includes bleached and semibleached kraft and bleached and unbleached sulfite.)

The main reason for this swing is that when many integrated companies run at full capacity, they must supplement their own pulp supplies by purchasing fiber on the open market. At the same time, some companies may stop selling pulp in the open market because they must supply their own integrated requirements during a strong market, thus contributing to the cyclicality of the market. However, overall market pulp capacity tends to creep higher in tight markets, as existing mills are debottlenecked or as production

MACHINE-DRIED WOODPULP CAPACITY

(000 metric tons)

Year	Total	Dissolving	Sulfite	Bleached sulfate	Unbleached sulfate	Other
1991e	10,427	1,272	377	5,418	163	108
1990e	10,191	1,272	377	5,196	163	108
1989e	9,981	1,272	377	5,060	163	108
1988	9,987	1,272	377	5,068	165	108
1987	9,747	1,265	374	4,924	152	108
1986	9,443	1,269	367	7,568	132	108
1985	9,315	1,313	358	7,417	130	106
1984	8,850	1,349	364	6,904	132	100
1983	8,618	1,455	377	6,555	132	99
1982	8,615	1,457	406	6,521	137	94
1981	8,462	1,450	450	6,291	172	98
1980	8,304	1,442	472	6,052	171	170
1979	7,779	1,393	486	5,625	99	176
1978	7,432	1,427	516	5,204	107	176
1977	7,235	1,495	579	4,818	161	181
1976	7,170	1,425	714	4,642	205	183
1975	7,167	1,516	709	4,608	217	119
1974	7,235	1,655	740	4,555	193	93
1973	6,994	1,596	728	4,392	191	88
1972	6,807	1,593	709	4,266	226	10
1971	6,717	1,605	609	4,173	245	4
1970	6,574	1,604	755	3,977	237	1

e = Estimate.

Source: American Paper Institute.

is shifted to higher-yield grades (e.g., from softwood to hardwood, or from dissolving to paper-grade pulp). U.S. chemical paper-grade market pulp capacity was revised upward by 850,000 metric tpy during the 1987-88 period.

INTERNATIONAL MARKET

The pulp market is international in nature, with large volumes of pulp moving duty-free between net-producing regions and net-consuming regions. North America and the Nordic countries are the largest market-pulp-producing regions, although nontraditional supplying countries with fast-growing plantations—Brazil, Portugal, Spain, and Chile—are growing in importance.

In 1988, North American and Nordic shipments of chemical paper-grade market pulp reached a new peak of 18.6 million metric tons—up 0.9% from 1987. Canada remained the single largest market-pulp-producing country with shipments of 7.2 million tons—down 0.4% from a year earlier. The U.S. was second with shipments of 6.4 million tons—up 2.9%. Nordic shipments totaled nearly 5.0 million tons—up 0.3%. Shipments from non-Norscan supplying countries totaled 7.9 million tons, bringing world shipments (excluding communist countries) to 26.5 million tons.

Since 1975, the share of world shipments from North America and the Nordic countries has declined from 76% to 70% in 1988. The share held by nontraditional countries has increased from 24% to 30%, and it is expected to continue increasing in the 1990s.

In 1987, however, traditional producers showed stronger shipment growth, capturing about 70% of the market. Nontraditional or "other" producers increased shipments by only 2% in 1987—considerably below their 6% average annual growth rate of the last decade.

During the 1976-87 period, chemical paper-grade market pulp shipments more than doubled from the U.S. and nontraditional producing countries, according to David F. McCaffrey, director of woodpulp for CPPA. Canada's shipments grew by 36%—a nearly 2.0-million-ton increase. Nordic shipments rose by only 340,000 tons—about 7%—reflecting forward integration into printing/writing papers production, particularly since the beginning of the 1980s.

Western Europe (excluding Scandinavia) remains the largest destination for world chemical paper-grade market pulp shipments, accounting for about 40% of total ship-

U.S. EXPORT TRENDS FOR WOODPULP

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached	Sulfate semibleached	Sulfate unbleached	Other
1988	5,016	785	356	27	3,644*	—	158	46
1987	4,415	681	338	35	3,197*	—	141	24
1986	4,044	645	288	24	2,886	17	131	53
1985	3,443	572	227	20	2,474	37	86	26
1984	3,260	540	239	9	2,272	69	82	49
1983	3,306	587	255	12	2,277	52	87	36
1982	3,080	573	190	7	2,139	57	90	25
1981	3,336	720	247	11	2,193	60	92	22
1980	3,452	698	292	23	2,180	84	103	73
1979	2,662	693	199	34	1,481	97	94	64
1978	2,358	687	172	18	1,270	84	69	56
1977	2,395	722	175	7	1,174	147	95	74
1976	2,284	662	164	11	1,180	95	103	67
1975	2,327	628	223	21	1,427	117	87	38
1974	2,252	714	259	22	1,308	81	141	16
1973	2,126	668	266	6	1,003	114	65	5
1972	2,044	720	205	2	1,092	115	70	3
1971	1,974	717	184	9	787	132	137	8
1970	2,808	778	326	31	1,192	223	230	11
1969	1,907	674	228	13	733	138	115	7
1968	1,738	609	206	8	578	191	134	11
1967	1,561	551	219	12	471	179	120	9
1966	1,404	511	190	24	326	126	99	9
1965	1,272	485	183	35	329	126	155	6

* = Includes semibleached.

Source: U.S. Dept. of Commerce.

ments. In 1988, western Europe consumed 10.9 million tons of pulp—up 3.4% from 1986. The U.S. was the second-largest market, consuming 5.5 million tons—about 3.7% more than the previous year. Japan was the third-largest market with demand of 2.9 million tons—up 5%. Other regions of the world—Asia, Latin America, and Africa—consumed nearly 5.2 million tons of market pulp in 1988—down 7.8% from 1987.

PULP MARKET CYCLES

The pulp market is highly cyclical, characterized by sharp inventory swings and rising or falling prices. When prices begin to rise, buyers rush to stock up on pulp. Rising shipments enable producers to run at full capacity and reduce their inventories. The tighter market emboldens them to demand still higher prices. This triggers another surge of buying and another spiral upward in the market cycle.

High pulp prices cause consuming paper mills to use substitutes such as secondary fiber (wastepaper) or to increase their captive pulp production. Prices may still rise after actual pulp consumption by paper mills has begun to decline. At some point, buyers realize that more than enough pulp is available, and they begin to reduce their inventories. Prices start to weaken, and buyers hold off on making any purchases in anticipation of lower prices. The downward market spiral is under way, and it may not stop until prices approach the break-even level for the average North American/Nordic producer, which usually triggers widespread industry production curtailments.

Market pulp cycles are also loosely related to underlying demand and supply conditions and to the general economy. Demand for market pulp is affected by production levels for paper and paperboard, which in turn reflect general economic activity. But the pulp market has sometimes gone down when the economy is strong, or it stages a recovery when general business conditions are weak. Ross Hay-Roe of *PaperTree Letter* has noted a two-year lag between turning points in the U.S. economy and changes in pulp prices.

Capital investment in the market pulp industry usually comes in surges during periods of rising prices and profitability. New mill construction usually takes two to three years. Once the wave of new capacity comes onstream, the market may weaken, resulting in oversupply and declining prices. As profitability declines, companies rein in capital spending, slowing down capacity expansion and setting the stage for the next period of market tightness.

Barometers used to gauge price changes include North American and Nordic producer inventories and operating rates for chemical paper-grade market pulp. Historically, market pulp prices tend to rise when ratios of shipments to capacity reach about 88% to 90%, and when inventories of North American and Nordic producers drop to around 1.2 to 1.3 million tons. When operating rates decline below this level and inventories increase, prices usually (but not always) begin to weaken.

Ronald J. Slinn, vice president of API's pulp group, has noted that from about 1970 to 1982, a curiously consistent two-year-nine-month time span existed between peaks and troughs in North American and Nordic producer inventory levels. This made the entire cycle (from peak-to-peak or trough-to-trough) slightly more than five years. However, the pattern broke in 1982 when, after only 19 months, a nine-week strike in British Columbia caused producer inventories to hit a low of 911,000 tons in March 1984. The next peak of 1.8 million tons came in February 1985 after only 11 months. Inventories reached a new low of 666,000 tons in December 1988—just over the two-year-nine-month historical pattern.

In addition to labor negotiations (particularly in British Columbia), another external factor that can affect the pulp market is governmental policy. Producer inventories hit an all-time high of 2.9 million tons in February 1977 due to a Swedish government program to subsidize inventory building in order to keep employment levels high.

Exchange-rate fluctuations have also had a growing impact on pulp prices. Fluctuations in the value of the dollar upset comparative cost relationships among major producing regions, and they affect the price of pulp for buyers in terms of their local currencies. The rise of the dollar during the 1980-84 period dramatically increased the cost advantage of Scandinavian and nontraditional producers, thus enabling them to price pulp more competitively. At the same time, weak currencies increased the cost of dollar-priced pulp for buyers in Europe and other overseas markets, and made them more resistant to pulp price increases. The dollar's decline since 1985 has dramatically improved the cost position of North American producers, and it has made price increases easier for buyers in Europe and Japan to accept.

Under 1984 price-fixing set-

SOURCES OF MARKET PULP CONSUMED IN THE U.S.

(000 tons)

Year	Domestic market pulp shipments	% of total	Market pulp imports	% of total	Total apparent consumption
1988	2,622	48%	2,896	52%	5,518
1987	2,557	48	2,753	52	5,310
1986	2,507	49	2,610	51	5,117
1985	2,355	50	2,318	50	4,673
1984	2,411	50	2,418	50	4,829
1976	1,679	44	2,116	56	3,759
1970	1,503	44	1,882	56	3,385

Source: American Paper Institute.

tlements with the European Community, Nordic producers price their pulp in European currencies. Although this measure was intended to reduce the "transparency" of the market, local currency prices in fact tend to equalize with the dollar price of pulp. The ruling was designed to help European pulp buyers who were being "scissored" between expensive dollar-priced pulp and increasing shipments of Nordic white paper pulp priced in local currencies. Ironically, the dollar began to decline not long after the ruling was made.

The combination of volatile exchange rates and dual-currency pricing tends to "lubricate" the movement of prices upward in a tight market, and it will probably make them come down faster in a weak market, according to Ross Hay-Roe. During the tight 1986-88 pulp market, North American producers used any weakness in the dollar as an excuse to raise their dollar prices to the level of local currency prices in Europe. Likewise, any strengthening in the dollar during this period was used by Nordic producers as an excuse to raise their local currency prices to North American dollar price levels in Europe. The result was an almost continuous series of dollar and/or local currency price increases from 1986 to mid-1989.

MARKET CONDITIONS

The world pulp market appeared to peak in mid-1989 and may be in the early stages of a downturn. While the price of benchmark NBSK in Europe reached $840/ton in the second quarter of 1989, it was probably the last of thirteen almost consecutive quarterly price increases since the beginning of 1986, during which time the dollar price of pulp more than doubled. This resulted in an unusually high but unsustainable level of industry profitability, with profit margins of many North American pulp producers reaching somewhere between 40% and 50%.

The main factors driving the dramatic recovery in pulp prices were the lengthy economic expansion, strong growth in printing/writing paper production, limited world market pulp capacity additions, and the decline of the dollar. With world chemical paper-grade market pulp capacity rising only about 2%/year during the past several years, pulp demand has been pushing against the limits of supply. North American and Nordic pulp mills ran at 96% to 97% of capacity during 1987-88, and producer inventories dropped to a nine-year low of 666,000 tons at the end of 1988.

As producer inventories were reaching new lows, purchased pulp inventories at paper mills were rising. Squeezed by the high pulp prices, customers sought substitutes such as new CTMP coming online in Canada, secondary fiber, and more clay fillers. Meanwhile, printing/writing paper production in the U.S. began to weaken due to an inventory correction by printers and paper distributors.

The first sign of trouble for market pulp appeared in the second quarter of 1989, when producers had difficulty raising second-quarter prices on hardwood pulp. This created a large gap ($80 to $100/ton) between softwood and hardwood prices, which typically occurs at the beginning of a market downturn. Reports of spot discounting, particularly on southern mixed hardwood pulp, also increased.

With some strengthening in the dollar, North American producers left dollar prices unchanged in the third quarter of 1989. However, the market was still strong enough for European pulp suppliers to raise softwood and, to a lesser

CANADIAN PRODUCTION OF MARKET WOODPULP BY GRADES

(000 metric tons)

Year	All grades	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate and soda bleached and semi-bleached	Sulfate unbleached	Mechanical
1988	n.a.	266	295	25	6,800	105	n.a.
1987	8,013	241	300	20	6,760	120	572
1986	6,608	223	289	18	6,174	121	552
1985	6,652	222	204	13	5,601	151	461
1984	6,729	221	234	28	5,558	155	533
1983	6,690	217	186	29	5,687	180	390
1982	5,823	219	160	47	4,894	184	319
1981	6,540	275	266	72	5,514	230	183
1980	7,156	313	271	90	6,005	242	235
1979	6,619	367	275	83	5,407	253	234
1978	6,132	334	262	75	5,037	215	209
1977	5,903	269	327	52	4,709	296	250
1976	5,954	254	368	81	4,703	287	261
1975	4,889	228	315	67	3,778	279	221
1974	6,286	351	356	156	4,746	405	272
1973	5,743	251	265	83	4,421	449	274
1972	5,021	253	282	83	3,384	328	241
1971	4,620	288	310	113	3,416	273	220
1970	4,857	326	389	187	3,379	297	279
1965	3,169	306	519	265	1,570	209	300
1960	1,908	198	309	166	771	222	242
1955	1,876	324	361	322	383	205	281
1950	1,356	293	232	339	142	193	159

n.a. = Not available.

Source: Canadian Pulp & Paper Assn.

extent, hardwood prices (with a small differential developing between birch and eucalyptus). Producers did not change either dollar or local currency prices in the fourth quarter.

With pulp prices no longer rising, buyers in Europe and Japan began to reduce their pulp inventories. This was expected to depress fourth-quarter shipment volume and cause producer pulp inventories to rise further. Producer pulp inventories by August 1989 had broken the 1.0-million-ton level. By year-end, they may reach 1.3 to 1.4 million tons—roughly double their level at the end of 1988.

Major new market pulp capacity in North America and Latin America is expected to start coming online in 1990. After increasing only 1.4% in 1989, world chemical paper-grade market pulp capacity is expected to increase 2.9% in 1990 and 3.2% in 1991. This would increase world capacity from 27.5 million tons in 1988 to 29.7 million tons in 1991—an increase of 2.15 million tons or 8%. In addition, mechanical market pulp (mainly from new CTMP mills) is projected to rise from 2.2 million tons to 2.8 million tons by 1991—an increase of 665,000 tons or 31%.

Because of all these factors, most analysts expect market pulp prices to decline in 1990-91, and some predict that prices could plummet by as much as $200 to $300/metric ton. This would lower prices to nearly the manufacturing cost levels of the world's higher-cost producers. If the two-year-nine-month cycle holds, pulp inventories will reach their high in the fall of 1991, and prices will probably begin to recover in early 1992.

NEW EXPANSION WAVE

High pulp price levels and attractive return on investment have stimulated a wave of expansion activity in chemical paper-grade market pulp. Over a dozen major market pulp expansions plus many smaller incremental projects around the world will add about 9.7 million tons of chemical paper-grade market pulp capacity by 1995. This includes only probable projects (net of some integration projects involving new paper machines).

Much of the new market pulp capacity is being built in North America and Latin America, and more than 70% of it consists of hardwood (particularly aspen and eucalyptus). These projects will lift total world chemical paper-grade market pulp capacity from 27.5 million tons in 1988 to 37.2 million tons in 1995—a 35% total increase or 5%/year during the next seven years. Ronald J. Slinn of API pointed out that this projected growth rate would be over one and a half times the 3.2% average annual growth rate of the last ten years.

In addition, world mechanical market pulp capacity is expected to rise from 2.3 million tons in 1988 to 2.7 million

CANADIAN MARKET PULP CAPACITY

(000 metric tons)

Year	Total	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached softwood	Sulfate semibleached	Sulfate bleached hardwood	Sulfate unbleached	Mechanical
1991e	9,460	252	286	54	5,784	425	1,251	110	1,298
1990e	8,991	252	286	54	5,716	392	1,034	110	1,147
1989e	8,812	273	300	41	5,664	374	935	115	1,110
1988	8,412	277	299	24	5,665	376	913	113	745
1987	8,179	245	307	24	5,533	473	873	125	599
1986	7,985	245	292	24	5,396	501	809	129	589
1985	7,769	266	270	35	5,233	420	794	177	574
1984	7,670	264	240	39	5,134	405	869	198	521
1983	7,641	201	250	72	5,130	453	780	208	500
1982	7,617	305	286	83	5,128	438	669	236	472
1981	7,430	303	313	84	5,056	433	634	290	317
1980	7,237	307	265	95	4,905	550	605	270	240
1979*	7,112	395	257	106	4,733	524	579	253	265
1978	7,381	424	354	137	4,739	537	590	297	253
1977	7,273	353	425	200	4,514	586	565	370	260
1976	7,224	408	527	202	4,306	562	621	339	259
1975	7,156	427	541	194	4,164	627	613	329	261
1974	6,955	404	472	192	3,976	742	594	354	221
1973	6,502	416	358	149	3,693	664	666	362	194

e = Estimate.
* = Not comparable with previous years' data due to change in method for estimating capacity.

Source: Canadian Pulp & Paper Assn.

tons in 1990 and to 4.1 million tons in 1995—a total increase of 80% at an average annual rate of 8.8%.

In North America, Weyerhaeuser Co. is building a 425,000-tpy bleached kraft pulp line at its Columbus, Miss., mill for startup in 1990, while Daishowa Paper Manufacturing Co. of Japan will complete a new 340,000-tpy hardwood kraft mill in Alberta in 1991. Parsons & Whittemore Inc. is building a new 450,000-tpy bleached softwood kraft line at its existing Claiborne, Ala., complex for startup in 1992. Some of the new market pulp capacity will be offset by integration projects at existing market pulp mills.

Several new mill projects in North America are facing stiff environmental opposition, including Alberta-Pacific Ltd.'s proposed 500,000-tpy bleached softwood/hardwood kraft mill in Alberta as well as two major pulp expansions in Oregon proposed by WTD Industries and Pope & Talbot Inc.

The greatest expansion activity is taking place in Latin America. In Chile, three new pulp mill ventures have been announced, two of them involving U.S. paper companies. Celulosa Santa Fe (backed by Scott Paper Co., Shell, and Citibank) is building a 235,000-tpy eucalyptus mill at Nacimiento for completion in 1991. Celulosa Pacifica, a joint venture between Simpson Paper Co. and Cia. Manufacturera de Papeles y Cartons SA (CMPC) is building a 315,000-tpy bleached kraft mill in Renaico based on radiata pine. Startup in slated for 1992. Celulosa Arauco y Constitucion SA is planning a 350,000-tpy expansion of its Arauco mill for completion in 1992.

In Brazil, three of four eucalyptus projects appear likely to move ahead during the first half of the 1990s. Aracruz Celulose SA is doubling the size of its eucalyptus mill, while Bahia Sul Celulose (a joint venture between Suzano de Papel e Celulose Cia. and the big mining firm Cia. Vale Rio Doce) is moving ahead with a market pulp mill that will be partially integrated with a paper machine. Cenibra (jointly owned by CVRD and Japanese interests) has approved plans for a 350,000-tpy expansion of its existing mill, doubling its size by 1991. Other new pulp mill projects are being studied in Brazil by Riocell, Norcell (a joint venture between Riocell and Compene), and a group of nonintegrated paper mills (Celmasul).

CANADIAN EXPORTS OF WOODPULP[1]

(000 metric tons)

Year	All grades[2]	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached hardwood	Sulfate bleached softwood	Sulfate semi-bleached	Sulfate unbleached	Mechanical
1987	8,241	213	395	40	591	6,005	353	112	312
1986	7,619	216	388	48	529	5,447	346	137	346
1985	7,025	174	292	49	507	5,047	344	152	360
1984	7,040	182	313	61	519	4,930	349	156	379
1983	6,823	177	283	50	477	4,981	340	166	314
1982	6,099	174	295	101	359	4,375	290	230	272
1981	6,744	221	424	86	429	4,627	399	281	270
1980	7,248	235	396	108	409	5,095	484	210	311
1979	7,090	241	482	104	341	4,929	429	248	317
1978	6,638	210	509	83	350	4,562	390	243	291
1977	6,092	130	564	81	341	4,032	372	295	276
1976	6,116	147	515	92	341	4,074	399	262	286
1975	5,001	125	414	82	285	3,271	294	331	189
1974	6,438	243	532	141	306	4,117	456	373	262
1973	5,939	208	385	107	381	3,677	471	448	253
1972	5,536	283	369	100	411	3,244	494	377	249
1971	5,149	316	387	115	392	2,893	482	342	210
1970	5,063	302	440	162	345	2,753	467	328	251
1965	3,495	349	570	239	1,501		202	333	284
1960	2,360	220	394	154	889		127	314	213
1955	2,146	299	415	337	608[3]		n.a.	201	238
1950	1,675	263	243	374	356[3]		n.a.	172	225

n.a. = Not available.

[1] Includes some pulp shipped to mills in the U.S. that have the same ownership. Such "tied" pulp, which totals about 1.0 million tons, is not included in market pulp shipments.

[2] Total includes screenings (not shown). Years 1950-60 include small amounts of soda pulp (not shown).

[3] Includes semibleached sulfate.

Source: *Statistics Canada.*

CHEMICAL PAPER-GRADE MARKET PULP CAPACITY OF MAJOR NORTH AMERICAN PRODUCERS

		Annual capacity* (000 metric tons)			Capacity
		U.S.	Canada	Total	share (%)
1	Weyerhaeuser[1,2,3,5,6]	550	660	1,210	8.5%
2	Georgia-Pacific[1,2,5,6]	1,115a	—	1,115	7.8
3	Canadian Pacific Forest Products[1,2,3,4]	—	840	840	5.9
4	International Paper[1,2,6]	820	—	820	5.8
5	Parsons & Whittemore[1,2]	425	230	655	4.6
6	Fletcher Challenge[1,3,4]	—	620b	620	4.3
7	Great Northern Nekoosa[1,2,3]	600	—	600	4.2
8	Champion International[1,2]	247	316c	563	3.9
9	Repap Enterprises[1,3,4]	—	550	550	3.9
10	Canfor[1,3,4]	—	520	520	3.6
11	MacMillan Bloedel[1,3,4]	—	500	500	3.5
12	Federal Paper Board[1,2]	483	—	483	3.4
13	ITT Rayonier[1,5,6]**	415	—	415	2.9
14	Stone Container[1,2,4]	220	190d	410	2.9
15	Noranda Forest[1,2,5]	—	390e	390	2.7
16	Western Forest[1,3,5,6]	—	355	355	2.5
17	Boise Cascade[1,3,4]	272	45	317	2.2
18	Bowater[1,3]	310	—	310	2.2
19	Donohue-St. Felicien[1]	—	300	300	2.1
20	Louisiana-Pacific[1,5,6]	290	—	290	2.0
21	Irving Forest[1]	—	280	280	2.0
22	Procter & Gamble (Buckeye)[1,6]**	100	100	200	1.4
23	Celgar Pulp[1]	—	195f	195	1.4
24	Crestbrook[1]	—	185	185	1.3
25	Domtar[1,2,3,4,5]	—	160	160	1.1
26	E.B. Eddy[1,2,4]	—	150	150	1.1
27	Mead[1]	—a	145	145	1.1
28	Port St. Joe[2]	145	—	145	1.0
29	Chesapeake[2]	145	—	145	1.0
30	Willamette Industries[2]	110	—	110	0.9
31	Waferboard[1]	—	110	110	0.9
32	Port Townsend[4]	100	—	100	0.8
33	Westvaco[1,2]	95	—	95	0.7
34	Temple-Eastex[1]	70	—	70	0.5

North American capacity (1989): 14.255 million metric tons
Capacity share of top five companies: 32.5%
Capacity share of top ten companies: 51.5%

Key to grades: 1—bleached softwood kraft; 2—bleached hardwood kraft; 3—semibleached softwood kraft; 4—unbleached softwood kraft; 5—bleached sulfite; 6—fluff pulp.

* = Capacity share based on equity ownership (excluding less than 50%-owned affiliates, which in many cases appear as separate listings).

** = Exact capacity difficult to estimate because company has some mills which also make dissolving pulp or because company is highly integrated.

a. Reflects Georgia-Pacific Corp.'s acquisition of Brunswick Pulp & Paper Co. from Mead Corp. and Scott Paper Co. in 1988.

b. Reflects all of Crown Forest (200,000 tpy) and British Columbia Forest Products (420,000 tpy), although latter is 71.3% owned.

c. Includes 84.6% of Weldwood Canada, which has a 50% interest in Cariboo Pulp & Paper (320,000 tpy).

d. Reflects Stone Container Corp.'s acquisition of Consolidated-Bathurst in early 1989.

e. Includes Fraser (115,000 tpy) and Maclaren Industries (130,000 tpy) and 50% of Northwood Pulp & Timber (290,000 tpy). MacMillan Bloedel (48% owned) shown separately.

f. Owned 25% by Stone-Consolidated, 25% by Power Corp., and 50% by a Chinese government agency.

In Europe, several major market pulp projects have been proposed in Finland, including Enso-Gutzeit Oy's joint venture with the Soviet Union to expand its Uimaharju mill. Other projects include Metsä-Botnia's plan to double the size of its Kaskinen mill to 820,000 tpy, and a joint venture by three producers to build a new greenfield mill in Kajaani by 1993. In Sweden, Södra has indicated plans to expand its Mönsterås mill by 400,000 tpy by 1995. In Spain, Euro-Galicia (consisting of Feldmühle AG of Fed. Rep. Germany and four Spanish paper producers) has submitted a plan to authorities for a 250,000-tpy bleached eucalyptus mill.

The large amount of new market pulp capacity being planned for the 1988-95 period will be difficult for the market to absorb. However, not every proposed mill will be built due to environmental or wood resource constraints. As noted earlier, several North American pulp mills are facing strong opposition from environmentalists. Similar pressure recently forced North Broken Hill Peko Ltd. and Noranda Forest Inc. to withdraw plans for a large new market pulp project in Tasmania.

COMPARATIVE PRODUCTION COSTS

The sharp rise of the U.S. dollar from 1980 to early 1985, and its even more dramatic fall in 1986-87, caused significant shifts in comparative cost advantage among the major traditional market-pulp-producing regions of the world.

The U.S. South again became the lowest-cost region for producing bleached softwood kraft market pulp, followed by the U.S. West Coast and British Columbia interior, according to a recent study prepared by Price Waterhouse for the Forest Sector Advisory Council, a Canadian government agency. Sweden and Finland, which were generally the lowest-cost traditional producing regions in 1983-85—have become the highest due to their strong currencies. (They also held this position in the late 1970s.)

In 1987, delivered manufacturing costs (excluding depreciation and interest) were estimated at $321/metric ton in the U.S. South, $362 on the U.S. West Coast, $370 in the British Columbia interior, $382 in eastern Canada, and $388 on the British Columbia coast, according to the Price Waterhouse study. Delivered manufacturing costs in Finland and Sweden were estimated at $470. (All figures in accompanying table were converted to U.S. dollars at average 1987 exchange rates.)

Since 1987, the cost disadvantage of the Nordic producers has decreased, particularly in relation to Canadian competitors. This is due to a stronger Canadian dollar in relation to the U.S. dollar, and to stronger U.S. and Canadian dollars in relation to Nordic currencies. In addition, woodfiber costs in 1989 more than doubled on the U.S. West Coast, and they rose sharply in coastal British Columbia.

As a result of these shifts, the U.S. West Coast and coastal British Columbia in 1989 probably had the highest delivered production costs ($470 to $490) after Finland ($490 to $500). Swedish producers improved their relative cost position to a level that was probably about equal to eastern Canada ($440 to $450). U.S. southern producers

OPERATING RATES FOR NORTH AMERICAN AND SCANDINAVIAN PAPER-GRADE MARKET PULP MILLS

Year	U.S.	Canada	Sweden	Finland	Norway	Total
1988	95	98	93	100	87	96
1987	100	98	90	96	100	97
1986	95	92	84	89	91	91
1985	86	86	81	84	89	86
1984	94	86	93	90	94	89
1983	89	88	87	82	90	85
1982	85	77	68	72	86	77
1981	90	89	79	89	83	97
1980	95	99	90	95	84	93
1979	88	93	82	94	n.a.	90
1978	92	83	70	71	n.a.	80
1977	87	80	62	58	n.a.	74

n.a. = Not available.

Source: Trade associations.

CHEMICAL PAPER-GRADE PULP SHIPMENTS BY NORTH AMERICAN AND SCANDINAVIAN PRODUCERS

(000 metric tons)

Year	U.S.	Canada	Sweden	Finland	Norway	Total	Brazil
1988	6,407	7,231	2,892	1,785	311	18,627	—
1987	6,227	7,260	2,864	1,770	342	18,461	1,359
1986	5,912	6,674	2,803	1,603	326	17,407	1,216
1985	5,183	6,058	3,036	1,632	299	16,208	1,256
1984	4,970	5,854	3,351	1,680	304	16,475	1,298
1983	4,816	6,219	3,122	1,743	202	16,102	1,259
1982	4,172	5,131	2,487	1,565	120	13,475	1,100
1981	4,248	6,024	2,816	1,839	134	15,061	1,060
1980	4,342	6,481	2,877	2,057	75	15,832	1,184
1979	3,781	6,078	3,335	2,030	112	15,336	765
1978	3,378	5,953	3,714	1,687	129	14,861	212
1977	3,030	5,327	3,167	1,304	172	13,000	55

Source: North American and Nordic trade associations.

still enjoyed the lowest delivered costs ($330 to $340), according to *Pulp & Paper Week* estimates based on application of 1989 exchange and inflation rates to the 1987 cost figures.

Based on peak price levels effective throughout most of 1989 on bleached softwood kraft ($840 on northern and $810 on southern delivered in Europe), pulp producers will enjoy a bonanza in profitability. Profit margins for U.S. southern producers will approach 60%, while British Columbia interior mills will make just under 50%. Even mills in the U.S. Pacific Northwest and on the British Columbia coast will probably do better than 40% (excluding interest and depreciation). Such profit levels, of course, cannot be sustained for long, but they help producers make up for long periods of poor profitability during the first half of the 1980s.

According to a study called "The Market Pulp Industry 1983-87," manufacturing costs in Sweden rose more rapidly than in any other region—up 22% in local currency during that five-year period. Fiber was the area where Swedish costs rose most rapidly, jumping 37% and reflecting a taxation system that does not provide much incentive for timber harvesting by private woodlot owners, the study noted. During the same five-year period, overall costs per ton (in local currencies) rose 5.9% in eastern Canada, 3.5% in Finland, 2.7% in the British Columbia interior, and 1.4% on the British Columbia coast. Overall costs actually declined in the U.S. South and on the U.S. West Coast—helped by rising mill utilization rates that reduced fixed costs per ton in all regions.

British Columbia lost its position in 1987 as the region with the lowest fiber costs. Chip prices on the coast rose sharply due to the buoyant pulp market and tightening chip supplies. Chip prices in the interior were directly linked to pulp prices until mid-1988, then the provincial government switched to a minimum price of $75/bdu (higher than the previous formula would have provided), according to the Price Waterhouse study.

Energy costs in Sweden and Finland are less than half the energy costs reported in all other regions except the U.S. South, where energy costs have dropped significantly since 1986. Mills in Scandinavia have lower energy costs largely because of cogeneration. In 1987, energy costs decreased or remained stable for all North American regions, mainly as a result of lower natural gas prices. Finland generates 100% of its electricity needs, compared with 83% in the U.S. South, 70% in Sweden, and 55% in the British Columbia interior. Other regions generated 50% or less of their needs, according to the Price Waterhouse study.

In 1987, labor costs at mills in Finland were lower than those in North America primarily because of high productivity (2.2 hours labor per daily ton of production) and lower wage rates. However, eastern Canada in 1987 reported the lowest cost per hour worked for operating labor—C$23/hour.

The average age of pulping facilities in Canada is between 18 and 20 years, compared with 13 years in the U.S. West, 9 years in the U.S. South, ten years in Sweden, and eight years in Finland.

Delivery costs are highest in the British Columbia interior, reflecting the distance of mills from offshore markets and relatively high rail costs. Scandinavian mills have the lowest delivery costs because of their proximity to European markets.

Among major hardwood-producing countries, Brazil probably has the lowest manufacturing costs, followed by Portugal and the U.S. South. The Nordic countries have the highest production costs. Aracruz of Brazil, one of the most efficient hardwood pulp mills, estimated its direct manufacturing costs in 1987 at $197/ton. If depreciation and interest are included, Brazil would lose some of its advantage because of the high capital costs of its new mills.

The capital costs for building new chemical market pulp mills have risen dramatically during the past 20 years. The cost of Leaf River Forest Products' 1,000-tpd bleached kraft mill at New Augusta, Miss., (startup 1984) was approximately $530,000/daily metric ton. This compares with a cost of around $315,000/ton to build the 1,000-tpd Alabama River Pulp Co. mill at Claiborne, Ala. (startup 1978), not

NORTH AMERICAN AND SCANDINAVIAN CHEMICAL PAPER-GRADE PULP SHIPMENTS BY MAJOR WORLD MARKETS

(000 metric tons)

Year	U.S.	Western Europe[1]	Japan	Nordic countries	To other countries	Total
1988	5,111	6,916	1,947	996	3,656	18,626
1987	4,953	6,686	1,755	1,095	3,974	18,461
1986	4,831	6,563	1,618	1,018	3,349	17,407
1985	4,466	6,157	1,353	933	3,299	16,208
1984	4,682	6,181	1,241	969	2,975	16,408
1983	4,603	6,457	1,207	951	3,201	16,102
1982	3,811	5,551	980	773	2,360	13,475
1981	4,197	6,409	947	897	2,611	15,061
1980	4,327	6,536	1,244	991	2,734	15,832
1979	4,493	6,587	1,017	993	2,246	15,336
1978	4,193	6,520	973	878	2,297	14,861
1977	3,838	5,653	689	733	2,087	13,000

1. Including U.K.

Sources: North American and Nordic trade associations.

to mention the $110,000/ton cost of the original Northwood Pulp & Timber Ltd. mill in British Columbia (startup 1966).

The cost of building new greenfield mills in tropical countries may run significantly higher. Aracruz, completed in the late 1970s, had an original capacity of around 400,000 tpy and cost more than $600 million, for an average cost of about $530,000/daily ton.

MECHANICAL PULPS

Mechanical pulps are produced by either the groundwood, refiner mechanical, or thermomechanical (TMP) pulping processes. A newer process, chemi-thermomechanical pulping (CTMP), is replacing the earlier processes for producing mechanical market pulp. The first CTMP mill was built in Sweden in the late 1970s, but the most dramatic growth for this process has occurred in Canada because of favorable wood and energy costs, government financial incentives, and willing entrepreneurs.

Since Quesnel River Co. started up the first CTMP mill in British Columbia in 1982, Canadian CTMP capacity has rocketed to about 900,000 tpy in 1989. Tembec Inc. (Temcell) brought on a new 100,000-tpy line at its Temiscaming, Que., mill in 1986. This was followed by three new mills in 1988: Cascades Inc.'s 210,000-tpy mill at Port Cartier, Que. (formerly a dissolving pulp mill); Millar Western Pulp Ltd.'s 210,000-tpy mill at Whitecourt, Alta.; and Fibreco Export Inc.'s 180,000-tpy mill at Taylor, B.C. Stone-Consolidated Inc. has also begun producing market pulp at its Bathurst, N.B., CTMP mill, which was originally designed to supply its Bridgewater, U.K., newsprint mill.

The main attraction of the CTMP process for potential market pulp producers is its lower capital costs and wood consumption. A new greenfield bleached CTMP mill can be built for less than half the cost of a new kraft market pulp mill (on a per-daily-ton basis), and a ton of CTMP can be produced with less than half the wood required to make a ton of bleached softwood kraft pulp. Because of its lower manufacturing costs, CTMP can be sold at 75% to 80% of the price of NBSK pulp—undoubtedly a major advantage to customers in the recently tight pulp market.

The first CTMP mills produced mainly higher-freeness softwood pulps that were used in tissue/towel applications. The newer mills are focusing on lower-freeness pulp, particularly aspen, for use in printing/writing papers. A large number of trials have been conducted at partially integrated and nonintegrated U.S. printing/writing paper mills, and the results have been both positive and negative. (No reliable production or shipment figures exist because some of the new producers do not belong to the Canadian Pulp & Paper Assn.)

"There are definite papers where [bleached CTMP] is presently not acceptable, and others where it is superior or offers cost advantages over other alternatives," said Dan Breck, vice president-marketing for Fibreco, at *Pulp & Paper*'s CTMP Markets Conference in September 1989.

A major barrier to the use of CTMP in woodfree printing/writing papers is "outdated grade classifications limiting mechanical pulp content to 10%," said Breck. Such rules equate bleached CTMP with earlier stone groundwood pulp and are no longer valid, he said. "Many papermakers and

NORTH AMERICAN AND SCANDINAVIAN PRODUCER INVENTORIES OF CHEMICAL PAPER-GRADE MARKET PULP

(000 metric tons)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1989*	874	889	760	804	852	773	945	1,027	—	—	—	—
1988*	915	905	837	821	767	677	804	845	772	797	852	666
1987	1,000	1,022	867	907	925	801	955	1,053	854	870	905	673
1986	1,330	1,306	1,131	1,024	1,080	943	1,014	1,030	894	890	1,018	847
1985	1,788	1,836	1,790	1,643	1,466	1,478	1,504	1,528	1,384	1,504	1,562	1,326
1984	1,303	1,084	914	1,003	1,034	1,039	1,247	1,349	1,309	1,490	1,635	1,616
1983	1,698	1,746	1,570	1,531	1,523	1,435	1,599	1,624	1,475	1,503	1,630	1,207
1982	1,579	1,690	1,767	1,744	1,840	1,878	1,876	1,923	1,748	1,840	1,809	1,603
1981	1,097	1,194	1,209	1,193	1,185	1,026	1,116	1,195	1,146	1,373	1,573	1,430
1980	745	741	747	754	801	745	813	916	830	933	1,094	949
1979	938	1,006	960	865	809	737	759	790	734	713	723	616
1978	2,119	2,016	1,857	1,776	1,612	1,288	1,188	1,193	1,069	1,046	1,038	903
1977	2,891	2,920	2,888	2,760	2,810	2,789	2,822	2,865	2,776	2,656	2,577	2,083
1976	2,121	2,260	2,373	2,408	2,474	2,588	2,638	2,749	2,720	2,809	2,882	2,824
1975	860	1,016	1,326	1,464	1,754	1,858	1,980	2,101	2,049	2,091	2,163	2,013
1974	628	628	625	595	565	532	545	557	538	550	567	611

* = Preliminary.

Source: North American and Nordic trade associations.

end users are aware of this but are restricted from using new types of fiber for fear of jeopardizing market position or incurring legal penalties."

Bleached CTMP is believed to have significant potential in printing/writing grades such as forms paper, uncoated bond, and some book papers. Brightness reversion is probably the biggest quality problem facing papers that contain CTMP. However, about one-third of the paper specifiers surveyed by NLK-Celpap Inc. said they would be willing to switch to a CTMP-containing grade if it suffered no brightness loss over a six-month period. Nearly two-thirds of respondents would be satisfied if there was no loss over a one-year period.

Initial brightness is not a major drawback now that new aspen CTMP pulps can be bleached to between 85 and 87 ISO, while spruce pulps can be bleached to between 80 and 82. These levels are close to bleached kraft pulp, and they are adequate for many paper grades, particularly if coatings and fillers are used. Although lower in tensile and tear strength than kraft pulp, CTMP is superior in bulk, opacity,

COMPARATIVE NORTH AMERICAN AND NORDIC REGIONAL MANUFACTURING COSTS FOR BLEACHED SOFTWOOD KRAFT MARKET PULP IN 1987

(US$/metric ton)

	British Columbia Coast	British Columbia Interior	Eastern Canada	U.S. West	U.S. South	Finland	Sweden
Wood fiber	$135	$115	$154	$111	$109	$298	$280
Chemicals	36	44	41	45	45	45	30
Energy	25	23	19	37	17	4	10
Labor	73	59	58	54	54	41	60
Other[1]	56	57	44	55	41	30	32
Mill level costs	325	298	316	302	266	417	411
Corporate and sales expense	16	12	16	9	11	14	14
Delivery	47	60	50	51	44	39	44
Total delivered cost[2]	388	370	382	362	321	471	470

1. Includes materials, maintenance services, and mill administration net of byproduct revenues.
2. Before depreciation and interest expense. (Depreciation costs ranged from $52 in the U.S. South to $15 to $20 in Canada due to differences in accounting practices.)

Source: Forest Sector Advisory Council, "The Market Pulp Industry 1983-87."

HISTORICAL TOTAL DELIVERED MANUFACTURING COST FOR BLEACHED SOFTWOOD KRAFT AND COMPARATIVE RANKING AMONG REGIONS[1]

(Rank in parentheses)
(US$/metric ton)

Year	British Columbia Coast	British Columbia Interior	Eastern Canada	U.S. West	U.S. South	Finland	Sweden
1988[2]	$439 (5)	$418 (3)	$420 (4)	$380 (2)	$325 (1)	$505 (7)	$439 (6)
1987	388 (5)	370 (3)	382 (4)	362 (2)	321 (1)	471 (7)	470 (6)
1986	353 (3)	335 (2)	354 (4)	369 (5)	323 (1)	414 (7)	408 (6)
1985	387 (7)	346 (2)	374 (5)	374 (6)	360 (4)	350 (3)	330 (1)
1984	427 (7)	398 (6)	376 (3)	379 (4)	385 (5)	344 (2)	314 (1)
1983	411 (7)	333 (3)	388 (5)	392 (6)	368 (4)	359 (2)	319 (1)

1. Before depreciation and interest expense. (Depreciation costs ranged from $52 in the U.S. South to $15 to $20 in Canada due to differences in accounting practices.)
2. *Pulp & Paper Week* estimate based on average 1988 exchange rates and assuming 5% increases in delivered cost/ton for British Columbia and the U.S. West Coast and smaller increases for other regions.

Source: Forest Sector Advisory Council, "The Market Pulp Industry 1983-87."

and absorbency (although the latter is a subject of dispute).

Another potentially large market for CTMP is in fluff applications for baby diapers and other sanitary products. Interest in CTMP, especially in Europe, has been spurred by concern about dioxin in bleached kraft fluff pulp. Some European diaper manufacturers, such as SCA's Peaudoce division, have introduced CTMP-containing diapers advertised as "environmentally friendly." Procter & Gamble has countered in Europe by using "chlorine-free" bleached kraft fluff in diapers, and it has reportedly increased market share in countries such as Sweden and the U.K. Consumers reportedly find the performance of kraft fluff diapers to be superior.

Despite such market uncertainties, about ten new bleached CTMP mills are either under construction or proposed, which will add about 1.7 million tpy of capacity during the 1990-93 period. Donohue-Matane will start up a 190,000-tpy CTMP mill at Matane, Que., in 1990. This will be followed by second lines at existing mills owned by Tembec (150,000 tpy) and Millar Western (210,000 tpy). Alberta Energy plans to build a new 120,000-tpy mill at Slave Lake, Alta., for startup in 1991 or 1992. Other new mills have been proposed by Louisiana-Pacific Corp., Shinho (in a possible joint venture between the Rep. Korean company and Abitibi-Price Inc.), Cascades, Fibreco, Alcan, and a Taiwanese paper company.

Acceptance of all this new CTMP market pulp capacity is uncertain, especially in light of declining prices and growing availability of competing hardwood kraft pulps. Some observers expect a shakeout in the CTMP industry, with some mills being integrated with newsprint, groundwood specialties, or coated paper machines. Aggressive pricing may be necessary to encourage papermakers to use the new pulp, although it could have a destabilizing effect on the overall pulp market in the current downcycle.

DISSOLVING PULP

Dissolving pulps, also referred to as chemical cellulose, are highly purified grades of market pulp composed of 95% to 99% cellulose. They are used to produce man-made fibers (rayon and acetate), films (cellophane), plastics (cellulose acetates), and chemicals (methyl cellulose and carboxylmethyl cellulose). Two processes are used to produce dissolving pulps, mainly from softwood although some hardwood is used: (1) the prehydrolyzed sulfate process, and (2) the modified acid sulfite process. By these processes, several grades of varying quality can be made, each suitable for different end uses.

The quality of a dissolving pulp grade for a particular process depends on its purity and reactivity. For example, sulfite dissolving pulps are generally considered to be the most reactive pulps, suitable for producing rayon and cellophane made under lenient rayon (viscose) processing conditions. Prehydrolyzed sulfate pulps generally produce a stronger rayon fiber for uses such as high-wet-modulus textile rayon and high-tenacity rayon tire cords. Cotton linter is also used to produce cellulose acetates and cellulose plastics, but it is rarely used for producing rayon fibers.

Chemical cellulose products can be divided into four groups based on the processes—viscose, acetate, ethers, and nitration—used to convert them: (1) Viscose products are the largest group and consume about 80% of the dissolving pulp shipped. About 75% of viscose production consists of rayon for textiles and tire cord, with the remainder going into cellophane and products such as sausage casings and sponges; (2) acetate products are the second-largest group and include textiles, cigarette filters, rigid packaging, photographic film, and high-quality plastics; (3) cellulose ethers are increasingly being used in pharmaceuticals, cosmetics, detergents, food products, superabsorbents, and additives for oil-well drilling muds; (4) cellulose nitrates are used in explosives, lacquers, printing inks, and rocket fuels.

Dissolving pulp producers in recent years have been hurt by sharp cost escalations for wood and energy, plus the growing acceptance of lower-cost synthetic fibers and films. Rayon staple, for example, is under heavy competitive pressure from polyester, while plastic films such as oriented polypropylene are displacing cellophane.

U.S. dissolving pulp production declined from a peak of around 1.6 million metric tons in the mid-1970s to a low of 988,000 tons in the 1982 recession. By 1988, it had recovered to 1.25 million metric tons. Canadian dissolving pulp

WORLD DEMAND FOR CHEMICAL PAPER-GRADE MARKET PULP

(000 tons)

Year	Total world demand	From North American/Nordic countries	From other countries	% from North American/Nordic countries
1988	26,710	18,725	7,985	70.1%
1987	26,365	18,460	7,905	70.0
1986	25,150	17,405	7,745	69.2
1985	23,450	16,095	7,355	68.6
1984	22,515	15,900	6,615	70.6
1983	22,320	15,895	6,425	71.2
1982	18,985	13,335	5,650	70.2
1981	19,970	14,490	5,480	72.6
1980	21,420	15,780	5,640	73.7
1979	20,505	15,310	5,195	74.7
1978	19,400	14,805	4,595	76.3
1977	17,060	12,995	4,065	76.2
1976	17,075	12,610	4,465	73.9
1975	14,900	11,290	3,610	75.8

1988 WOODPULP EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

	Exporters					
Major importers	**U.S.**	**Canada**	**Sweden**	**Finland**	**Norway**	**Brazil**
EUROPE						
Austria	20	33	89	40	5	3
Belgium	43	169	138	28	16	38
Czechoslovakia	1	—	22	29	11	—
Denmark	1	2	57	13	24	8
Finland	7	11	21	—	12	—
France	261	246	308	150	69	58
German Dem. Rep.	—	5	12	26	2	6
Germany, Fed. Rep.	565	660	756	431	91	79
Greece	19	14	22	27	—	—
Hungary	—	0	39	9	2	—
Ireland	—	14	—	4	—	—
Italy	362	421	352	127	47	23
Netherlands	116	140	164	71	54	20
Norway	—	—	63	2	—	0
Poland	9	0	30	18	13	—
Portugal	4	1	5	7	2	—
Spain	84	45	70	12	8	2
Sweden	4	10	—	21	48	14
Switzerland	26	73	82	49	9	4
U.K.	260	386	323	249	79	61
U.S.S.R.	28	29	—	111	85	—
Yugoslavia	6	8	24	3	1	2
Other Europe	2	2	15	3	11	—
Total Europe	1,818	2,269	2,592	1,427	589	318
NORTH AMERICA						
Canada	141	—	3	—	—	7
U.S.	—	3,934	83	36	—	291
Total North America	141	3,934	86	36	—	298
ASIA/AUSTRALASIA						
Australia	23	96	13	28	1	5
China, People's Rep.	153	203	66	30	9	12
Hong Kong	20	48	—	—	—	—
India	38	70	36	9	9	1
Indonesia	67	58	19	6	—	—
Iran	—	3	7	—	—	—
Iraq	58	0	1	—	—	—
Israel	38	9	10	15	—	—
Japan	1,085	1,240	103	45	3	202
Korea, Rep.	386	178	22	16	1	9
Taiwan	176	131	43	11	—	11
Thailand	14	33	5	3	—	—
Turkey	18	12	22	10	3	—
Other Asia/Australasia	67	31	25	11	2	4
Total Asia/Australasia	2,143	2,111	372	186	28	238
LATIN AMERICA						
Argentina	7	6	—	—	—	11
Colombia	6	1	—	—	—	7
Mexico	280	53	1	—	3	7
Venezuela	130	50	—	—	—	16
Other Latin America	34	19	2	1	—	9
Total Latin America	457	129	3	1	3	51
AFRICA						
Algeria	14	0	18	20	—	—
Egypt	16	0	8	1	—	—
Morocco	1	0	15	5	—	—
South Africa	11	1	—	—	—	0
Other Africa	1	4	18	6	6	5
Total Africa	43	5	59	31	6	5
WORLD TOTAL	4,602	8,448	3,112	1,679	628	915

Source: *Pulp & Paper International*, Annual Review, July 1989.

production followed a similar trend, declining from a peak of 450,000 tons in 1969 to 266,000 tons in 1988. ITT Rayonier shut down a troubled 260,000-tpy sulfite dissolving and paper-grade pulp mill at Port Cartier, Que., in 1979, and CIP Inc. closed its older 91,000-tpy Hawkesbury, Ont., sulfite dissolving pulp mill at the end of 1982. In addition, about 400,000 tons of capacity at eight mills in western Europe were either shut down or converted to other grades during the 1981-85 period.

Even with the capacity shutdowns, dissolving pulp remained in oversupply during the first half of the 1980s. Prices for 91 to 92 alpha viscose rayon staple grades dropped to a low of about $500/metric ton in the U.S. during the 1985 market downturn. Prices fell below $400 in some Southeast Asian markets due to strong competition from Saiccor (Pty) Ltd., a highly efficient South African mill owned by Courtaulds Ltd. This put heavy financial pressure on most Pacific Coast dissolving sulfite pulp mills. Alaska Pulp Co., a Japanese-owned mill at Sitka, ran up losses totaling more than $100 million during this period. Higher-alpha pulps used for acetate and other specialties held up better during the market downturn because they had fewer producers (a handful of southern mills using the prehydrolized kraft process) and more specialized markets.

The sharp rise in paper-pulp prices led to a pickup in dissolving pulp prices, beginning in depressed export markets and spreading to the U.S. market in 1987. By the third quarter of 1989, the price of 91 to 92 alpha viscose had reached about $880 to $890/metric ton. Among acetate grades, 96 to 97 alpha was reported in the $930-to-$970 range in the U.S.

The recovery of prices helped restore a more normal differential between paper pulp and dissolving pulp grades, which are more expensive to produce. But the rapid climb of prices was difficult for customers such as cellophane and rayon producers to absorb, and concern mounted that some might be forced out of business. Avtex Fibers Inc., the largest U.S. rayon producer, shut down most production at its Port Royal, Va., plant in 1989, due mainly to environmental pressure. And in 1988, Courtaulds shut down the last cellophane manufacturing plant in Canada.

ITT Rayonier, the largest North American dissolving pulp producer, predicted that chemical cellulose products will grow at about a 1%/year rate. On a tonnage basis, most of this growth is expected to be in regular rayon staple, which is in demand mainly in Asia. Demand from eastern Europe also recently picked up due to shutdown of some capacity in the U.S.S.R. The fastest percentage growth is

MAJOR MARKET PULP PRODUCERS OUTSIDE NORTH AMERICA*

(000 metric tpy)

Company	Capacity
Stora (Sweden	1,100
Södra Skogsägarna (Sweden	950
Metsä-Serla (Finland)	890
Mo och Domsjö (Sweden)	725
Sappi (South Africa)	650
Portucel (Portugal)	550
Aracruz (Brazil)	500
ENCE (Spain)	480
Cel. du Rhone et d'Aquitane (France)	440
Cel. Arauco y Constitución (Chile)	420

* = Approximate capacities (includes dissolving, fluff, and mechanical pulp grades).

WORLD MARKET PULP SHIPMENTS BY GRADE

(000 metric tons)

Year	Bleached softwood sulfate	Bleached hardwood sulfate	Unbleached sulfate	Bleached sulfite	Unbleached sulfite	Chemical paper-grade	Mechanical	Total
1988p	23,215*		1,675	1,690	130	26,710	n.a.	n.a.
1987	13,370	9,355	1,705	1,795	145	26,370	1,685	28,055
1986	12,815	8,805	1,690	1,755	130	25,195	1,695	26,890
1985	11,795	8,085	1,650	1,760	160	23,450	1,605	25,055
1984	11,210	7,790	1,605	1,700	210	22,515	1,545	24,060
1983	11,130	7,485	1,815	1,695	195	22,320	n.a.	n.a.
1982	9,535	6,230	1,715	1,300	205	18,985	n.a.	n.a.
1981	10,380	6,245	1,845	1,710	290	20,470	n.a.	n.a.
1980	10,680	6,370	2,025	1,935	410	21,420	n.a.	n.a.

p = Preliminary.
n.a. = Not available.
* = Total bleached sulfate (softwood and hardwood).

Source: Canadian Pulp & Paper Assn.

expected to be in high-performance rayons (such as high-wet-modulus staple, which offers cotton-like quality and high durability) and in cellulose ethers and nontextile acetate uses such as cigarette filters. Other cellulose acetate markets are fairly stable, with the exception of cellophane, which is expected to continue declining.

Efforts are also being made to improve the viscose process, which is highly capital- and energy-intensive and involves toxic and flammable chemicals. In the process, cellulose is treated with caustic soda and carbon disulfide to form cellulose xanthate, which is then dissolved in a weak caustic solution to form the viscose used to spin rayon staple. U.S. producers that still make rayon include BASF Fibers Div. and Courtaulds North America Co.

World dissolving pulp capacity has been eroding due to poor profitability and costly environmental cleanup deadlines faced by some older mills. World capacity dropped from 6.1 million tons in 1983 to 5.1 million tons in 1988. However, an increase to 5.3 million tons is expected by 1993, according to the Food & Agriculture Organization of the United Nations. Besides North America, dissolving pulp capacity has also declined in western Europe and Japan. Capacity in the Soviet Union dropped from 1.6 million tons in 1983 to 670,000 tons in 1988, reportedly due to the closure of one or two mills for environmental reasons. The two Alaska dissolving pulp mills, which obtain most of their wood from national forestland, face an uncertain timber supply outlook.

Despite these negative signals, some new dissolving pulp capacity may be built. Formosa Plastics, the largest company in Taiwan, has held discussions with the Louisiana state economic development agency about a new 1,000-tpd dissolving pulp mill and rayon plant. Saiccor is also studying an expansion at its South African mill.

WORLD CHEMICAL PAPER-GRADE MARKET PULP CAPACITY[1]

(000 metric tons)

	1988	1989e	1990e	1991e
Canada	7,390	7,430	7,590	7,910
U.S.	6,770	6,825	7,050	7,245
Norway	350	360	360	360
Finland	1,815	1,820	1,820	1,850
Sweden	2,990	2,920	3,030	3,005
North America/Nordic	19,315	19,355	19,850	20,370
Austria	390	390	390	390
Belgium	225	235	240	240
France	935	975	1,030	1,065
Fed. Rep. Germany	130	130	130	130
Italy	50	50	50	50
Portugal	1,260	1,295	1,300	1,340
Spain	725	730	750	760
Switzerland	125	125	125	125
Western Europe	3,840	3,930	4,015	4,100
Argentina	235	275	280	280
Brazil	1,465	1,580	1,645	1,915
Chile	555	575	595	695
Mexico	205	205	205	40
Latin America	2,460	2,635	2,725	2,930
Japan	715	715	715	715
Australia	35	25	25	25
New Zealand	285	275	305	305
Oceania	320	300	330	330
Indonesia	15	100	190	235
Morocco	105	105	115	130
South Africa	160	160	160	160
Rep. Korea	155	150	150	190
Swaziland	170	170	180	200
Taiwan	285	320	335	335
Asia/Africa	890	1,005	1,130	1,250
Total world[2]	27,540	27,940	28,765	29,695

e = Estimate.

1. Practical maximum: 100% of nominal capacity for North America, Nordic, Latin America; 97% for western Europe; 95% for Oceania, Asia, Africa; and 90% for Japan.
2. Excludes eastern Europe and People's Rep. China.

Source: North American and Nordic pulp and paper associations.

FLUFF PULP

Fluff pulp is usually produced in roll form and shipped to manufacturers of sanitary disposable products, who then disintegrate the thick pulp sheets into individual fibers in order to give their products bulk, softness, and high absorbency. Fluff pulp is used mainly in baby diapers, which account for about 80% of U.S. consumption. Other uses include adult incontinence products, tampons, sanitary napkins, underpads, and wipes.

Fluff pulp is made primarily from bleached softwood kraft (chiefly southern pine) and is similar to paper-grade pulp. It is somewhat more expensive to produce than other pulps, due to special sheet properties (which may include treatment with debonders) and packaging. Several North American sulfite mills are trying to increase fluff pulp production, although southern kraft appears to be favored for most applications because of its high absorbency. While mechanical fluff pulp production is growing in Europe and two new Ca-

MAJOR WORLD CHEMICAL PAPER-GRADE MARKET PULP EXPANSIONS

Company	Location	Capacity (000 metric tpy)	Startup date
CANADA			
Cariboo Pulp & Paper	Quesnel, B.C.	50 BSK	1989
Weldwood of Canada	Hinton, Alta.	120 BSK	1989
Canadian Pacific Forest Products	Dryden, Ont.	(140 BSK)	1989
James Maclaren	Thurso, Que.	70 BHK	1990
Repap Enterprises	Miramichi, N.B.	(50 BSK)	1990
Repap Enterprises	The Pas, Man.	170 BHK**	1991
Daishowa	Peace River, Alta.	340 BSK/BHK**	1991
Howe Sound Pulp & Paper	Port Mellon, B.C.	125 BSK	1991
Alberta-Pacific	Athabasca, Alta.	500 BSK/BHK	1992
Procter & Gamble*	Grand Prairie, Alta.	250 BSK/BHK**	1992
James River	Marathon, Ont.	175 BSK	1992
Malette Kraft Pulp & Power	Smooth Rock, Ont.	BSK/BHK	1992
Repap Enterprises*	The Pas, Man.	450 BSK/BHK	1993
Celgar Pulp	Castlegar, B.C.	200 BSK	n.a.
U.S.			
Federal Paper Board	Rieglewood, N.C.	150 BSK/BHK	1989
ITT Rayonier	Jesup, Ga.	50 BSK	1989
Georgia-Pacific	Woodland, Maine	90 BHK	1989
Bowater	Calhoun, Tenn.	70 BHK	1989
Nekoosa Paper	Ashdown, Ark.	80 BHK	1989
Champion International	Quinnesec, Mich.	(100 BHK)	1990
Weyerhaeuser	Columbus, Miss.	425 BSK/BHK	1990
Union Camp	Eastover, S.C.	100 BSK	1991
Stone/Savannah	Port Wentworth, Ga.	240 BSK	1991
Alabama River	Claiborne, Ala.	450 BSK	1992
Pope & Talbot*	Halsey, Ore.	240 BSK	1992
WTD Industries*	Pt. Westwood, Ore.	300 BSK	1992
EUROPE			
MoDo	Husum, Sweden	65 BSK/BHK	1989
Alicel	Alizay, France	120 BHK	1990
Portucel	Setubal, Portugal	110 BHK	1990
ENCE	Spain (2 mills)	120 BHK	1990
Stora	Skütskar, Sweden	140 BSK	1990
Veitsiluoto	Oulu, Finland	(150 BSK)	1991
Soporcel	Lavos, Portugal	(150 BHK)	1991
Enso	Uimaharju, Finland	350 BHK**	1992
Pojan Sellu	Kajaani, Finland	135 BSK/BHK	1993
Metsa-Botnia	Kaskinen, Finland	485 BSK/BHK	1993
Cel. d'Acquitane	St. Gaudens, France	120 BHKP	1990-94
Södra	Mönsteras, Sweden	400 BSK	1995
Euro-Galicia* (Feldmuhle/ four Spanish producers)	Galicia, Spain	250 BHK**	n.a.
LATIN AMERICA			
Cel. Bahia	Camacari, Brazil	90 BHK	1990
Jari	Monte Dovrado, Brazil	50 BSK/BHK	1991
Aracruz	Espirito Santo, Brazil	525 BHK	1991
Cel. Santa Fe (Scott/Shell)	Nacimiento, Chile	235 BHK	1991
Cel. Pacifica (CMPC/Simpson)	Renaico, Chile	315 BSK	1992
Bahia Sul	Mucuri, Brazil	200 BHK†	1992
Puerto Piray*	Missiones, Argentina	210 BSK/BHK	1992
Cel. Arauco	Arauco, Chile	350 BSK	1992
Cenibra*	Belo Oriente, Brazil	400 BHK	1992
Champion International	Mato Grosso, Brazil	100 BHK†	1993
Compener*	Bahia, Brazil	340 BHK	1994
Riocell	Guiaba, Brazil	310 BHK	1994
Celmasul	Mato Grosso, Brazil	350 BHK**	1995
ASIA			
Indah Kiat*	Riav, Indonesia	100 BHK**	1991
Dong Hae*	Kyungman, Rep. Korea	200 BHK	1991
Phoenix	Bangkok, Thailand	100 BHK	1992

BSK = bleached softwood kraft; BHK = bleached hardwood kraft.
* = "Possible" projects. All other projects are considered "definite" or "probable."
** = Not all pulp for market sale.
† = Reflects new paper machine.
n.a. = Not available.
( ) = Indicates capacity withdrawal due to a new paper machine.

nadian bleached CTMP mills are targeting the fluff market, acceptance in the U.S. market is uncertain.

Fluff pulp was the fastest-growing major end use for the U.S. market pulp industry; consumption rose at a 7% to 8% average annual rate during most of the past decade. But in 1987, U.S. consumption probably declined, and domestic demand is projected to show relatively slow growth throughout the 1990s. The reasons for this include lower U.S. birthrates, the already high penetration of disposable diapers in the U.S., and the growing use of superabsorbent material in new thinner "ultra"-style baby diapers, which contain less fluff pulp.

According to a study prepared by Kenneth E. Lowe for Marketing/Technology Service Inc. (M/TS) of Kalamazoo, Mich., the U.S. population of infants 30 months old and younger will peak around 1990 and then decline during the next decade. Disposable diapers have already captured 78% of the U.S. market at the expense of cloth diapers, and their share will probably increase to 90% by 2000. As a result, Lowe projected that disposable diapers in the U.S. will increase from 17.8 billion units in 1987 to 20 billion units by the year 2000—only an 11% increase.

At the same time, the growing use of superabsorbents is reducing by about 30% the amount of fluff pulp required per diaper. Superabsorbents can absorb up to 50 times their weight in liquid, thereby permitting the design of thinner baby diapers and less obtrusive adult incontinence products. Typically, about 5.0 g of superabsorbent material (usually polyacrylate powder or granules) is used per diaper. This results in a reduction of fluff pulp used in an average infant diaper from 50 g to 34.7 g.

Since their introduction less than two years ago, the new diapers containing superabsorbents have captured more than 50% of the U.S. diaper market, and they may hold over 90% by 1990, Lowe said. As superabsorbents have become more prevalent, U.S. fluff pulp consumption for use in baby diapers has dropped from an estimated 811,000-ton peak in 1986 to 715,000 tons in 1987. Lowe predicted it will decline further to 691,000 tons by 1990 and 680,000 tons by 2000. (Only estimates can be made of market size because fluff is included with paper-grade pulps for statistical purposes, and some producers closely guard their capacity figures.)

This loss in fluff pulp demand for baby diapers is expected to be made up largely by improved demand for adult incontinence products, due to an aging population and increased market penetration by disposables. Adult incontinence products currently consume about 121,000 tons of fluff pulp (about equally divided between retail and institutional markets), and demand is projected to roughly double to 252,000 tons by 2000.

As a result, overall U.S. domestic demand for fluff pulp will remain nearly constant, rising from about 900,000 tons in 1987 to 982,000 tons by the year 2000, Lowe estimated. The share of fluff pulp consumed in baby diapers will decline from about 81% currently to 69% by 2000, while use in adult incontinence products will rise from 6% to 26%. Usage in feminine pads will remain relatively stable at 5% to 6%.

Stronger growth in export demand should help boost total U.S. fluff pulp production, which was an estimated 1.6 million tons in 1987. Of that amount, about 900,000 tons were consumed in the domestic market, and about 740,000 tons were exported, according to Lowe. Although North America supplies about 70% of total world fluff pulp demand, stronger growth should occur in Europe, Japan, and the less industrialized countries due to their growing use of disposable diapers. The market share of disposable diapers in Japan was expected to grow from about 8% in the early 1980s to 34% in 1986, and it could reach 64% by 1990, according to Uni-Charm Corp., a major Japanese diaper manufacturer. The strong disposable unit growth should more than offset increasing use of superabsorbents in Japan and Europe.

WORLD CHEMICAL PAPER-GRADE MARKET PULP SHIPMENTS BY DESTINATION

(000 metric tons)

Year	U.S.	Canada	Western Europe	Nordic	Eastern Europe	Latin America	Japan	Asia/ Africa*	Oceania	Total
1988p	5,515	965	11,015	1,030	310	1,570	2,945	3,080	280	26,710
1987	5,310	970	10,545	1,135	300	1,835	2,780	3,190	305	26,370
1986	5,130	890	10,315	1,130	285	1,705	2,595	2,865	280	25,195
1985	4,700	845	9,445	1,000	210	1,620	2,395	3,010	225	23,450
1984	4,835	845	9,280	995	230	1,275	2,290	2,520	245	22,515
1983	4,720	735	9,145	980	255	1,015	2,260	2,955	255	22,320
1982	3,940	605	8,120	820	260	935	1,950	2,080	275	18,985
1981	4,325	750	9,010	930	380	865	1,800	2,095	315	20,470
1980	4,420	735	9,145	1,025	470	1,190	2,330	1,770	335	21,420

p = Preliminary.

* = Includes People's Rep. China (which purchased 470,000 metric tons from North American and Nordic suppliers in 1988—down from 520,000 tons in 1987 and the peak of 600,000 tons in 1983).

Total U.S. effective fluff pulp capacity is estimated at nearly 2.0 million tons. Major producers with capacity shares over 20% include Weyerhaeuser Co., Buckeye Cellulose Corp., and International Paper Co. Next largest are ITT Rayonier at around 14%, and Kimberly-Clark Corp. at nearly 9%, according to M/TS. Other smaller producers include Georgia-Pacific Corp., Brunswick Pulp & Paper Co., Tembec Inc., Western Forest Products Ltd., and Temple-Eastex Inc. Weyerhaeuser is believed to be the largest open market seller of fluff pulp, while P&G and K-C consume it mainly for captive use.

Total world effective fluff pulp capacity is estimated by the M/TS study at 2.8 million metric tons, of which 835,000 tons are outside North America. Most of this capacity is in western Europe and includes about 195,000 tons of bleached CTMP/TMP pulp. Major European players include Stora Kopparbergs, Cellulose du Pin, Korsnäs-Marma AB, and Metsä-Serla.

Because it is more expensive to produce, fluff pulp normally sells at a premium to southern pine paper pulp. The third-quarter 1989 list price for untreated softwood kraft fluff pulp in rolls was $830/ton in the U.S. vs a list for southern pine paper pulp of $800/ton. Prior to 1987, the differential was more like $50/ton.

Another major new development that could lead to further displacement of fluff pulp is the possible use of synthetic fibers in combination with fluff. The synthetic fiber that is being most widely experimented with is Hercules Inc.'s Pulpex (Type E 338), which is similar in length and morphology to woodpulp. At least two U.S. fluff pulp producers—Weyerhaeuser (at Plymouth, N.C.) and Temple-Eastex (at Evadale, Texas)—are offering fluff blends containing about 15% to 20% polyethylene fibers. Such blends can be thermally bonded by the absorbent products convert-

U.S. DOMESTIC PRICES FOR BLEACHED KRAFT MARKET PULP

($/metric ton, delivered)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1989				
4Q	$830	$800*	$745/765*	$735*
3Q	830	800*	745/765	735*
2Q	830	800	745/765	735
1Q	800	780	745	735
1988				
4Q	760	735/740	705	685/695
3Q	735	705/715	705	685/695
2Q	700	670	665	650
1Q	655	630	620	610
1987				
4Q	610	585	575	565
3Q	575	550	540	530
2Q	575	550	540	530
1Q	550	520	510	500
1986				
4Q	480	490	470	460
3Q	480	450	425	420
2Q	450	420	385	380
1Q	410	360/385	340/360	320/345
1985				
4Q	400*	360	330/360*	320*
3Q	400/425*	375	350/380*	340*
2Q	425*	385	370/400*	360*
1Q	450*	425	400/410*	390*
Year-end				
1984	510*	475	460/470*	450*
1983	440	415/425*	410/420	390/400
1982	440	385*	364/380*	353*
1981	530/565	495	468/490*	424*
1980	530	507	490	480
1979	460	400	433	420
1978	375	353	342	330
1977	342*	287	276*	260*
1976	410	353	331	310
1975	410	353	369	353
1974	386	386	369	353
1973	259	246	248	213
1972	179	180	149	150
1971	165*	160	149*	148*
1970	188	180	171	170

* = Indicates some discounting from price levels shown above.

HISTORIC PRICES, 1950-69, FOR NORTH AMERICAN MARKET PULP

Average annual prices for bleached kraft pulp, delivered in U.S. domestic market (US$/short ton)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1969	$145	$133	$131	$129
1968	145	123	118	115
1967	150	129	130	124
1966	148	135	136	129
1965	150	144	135	133
1964	146	141	128	130
1963	139	132	130	124
1962	143	129	134	124
1961	145	135	135	130
1960	156	151	151	146
1959	157	157	152	152
1958	157	157	152	152
1957	153	155	151	150
1956	151	154	149	149
1955	146	149	144	144
1954	142	145	140	140
1953	142	145	140	140
1952	142	145	—	—
1951	139	—	—	—
1950	120	—	—	—

er, using either through-air bonding or infrared heating equipment.

When heated to near its melting point, the plastic fibers bind all of the fibers in the pad. As a result, the pad maintains its shape better and does not collapse ~~upon wetting~~. Because of these advantages, absorbent products can be designed thinner, lighter, and stronger. However, the fluff pulp/polymer fiber blends are significantly more expensive (about $900/metric ton vs $560 for 100% southern pine fluff pulp). Reduction in core weights may compensate for the higher-priced material, particularly when superabsorbent is included. A few products using this new technology are already being marketed in Europe, the U.S., and Japan.

The baby diaper business in the last few years has been marked by intense product development activity and shorter product cycles. About 80% of the U.S. diaper market is held by two companies: Procter & Gamble (with Pampers and Luvs holding about a 50% share) and Kimberly-Clark (with Huggies at slightly over 30%). The remainder is split among more than a dozen companies (the largest include

U.S. DOMESTIC PRICES FOR OTHER PAPER-GRADE MARKET PULPS

($/metric ton, delivered)

Year	Bleached sulfite	Unbleached softwood kraft	Bleached CTMP (75 to 80 GE bright)
1989			
4Q	$790	$650/665*	$640*
3Q	790	650/665*	640*
2Q	790	650/665*	640
1Q	770	650/665*	
1988			
4Q	730	650/665	625
3Q	715	650/665	600
2Q	660/670	635/665	560/565
1Q	610/620	590/620	510/540
1987			
4Q	565/575	545/575	470/500
3Q	530/540	505/540	440
2Q	530/540	505/540	440
1Q	505	475/510	420
1986			
4Q	470	440/480	385
3Q	440	420/440	385
2Q	410	405	360
1Q	355	360	330
1985			
4Q	355	360	360
3Q	370	380	360
2Q	380	380	360
1Q	410	390	390
Year-end			
1984	455	430	415
1983	420/430*	370	365
1982	420*	360*	—
1981	520	490	—
1980	520	490	—
1979	450	422	—
1978	358	310	—
1977	320*	280*	—
1976	400	380	—
1975	400	380	—
1974	365	353	—
1973	255	225	—
1972	168	155	—
1971	160*	140*	—
1970	180	160	—

* = Indicates some discounting from price levels shown.

U.S. DOMESTIC PRICES FOR SPECIALTY PULPS

($/metric ton, delivered)

Year	Fluff (untreated bleached softwood kraft in rolls)	Dissolving (sulfite viscose staple grade, 91 to 92 alpha)
1989		
4Q	$830	$880/900
3Q	830	880/900
2Q	820/830	850/870
1Q	800	810/830
1988		
4Q	760	800/810
3Q	735	760/780
2Q	690/700	710/720
1Q	660	660/670
1987		
4Q	615	615/635
3Q	580	580/600
2Q	580	540/560
1Q	560	550
1986		
4Q	540	510
3Q	500	510
2Q	475	500
1Q	440	500
1985		
4Q	440	500
3Q	440/460	505
2Q	460/475	510
1Q	493	515
Year-end		
1984	535/555	530
1983	470*	525
1982	485*	530
1981	572/607	620
1980	550	670
1979	475	530
1978	—	430
1977	—	455
1976	—	468
1975	—	425

* = Indicates some discounting from price levels shown.

J&J's Chicopee Div., Weyerhaeuser, Whitestone Products Corp., and Pope & Talbot Inc.). While most private-label producers were able to adopt "ultra" superabsorbent diaper technology, they may have more difficulty imitating the next round of designs from P&G and K-C, according to James P. Hanson, director of M/TS.

NORTH AMERICAN EXPORT PRICES FOR BLEACHED KRAFT MARKET PULP

(US$/metric ton, c.i.f. northern Europe)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1989				
4Q	$840	$810	$790	$780*
3Q	840	810	790	780*
2Q	840	810	790	780
1Q	810	780	770	760
1988				
4Q	760	730	720	710
3Q	760	730	720	710
2Q	725	695	690	680
1Q	680	655	650	640
1987				
4Q	635	610	600	595
3Q	610	585	575	570
2Q	585	560	550	545
1Q	550	525	515	510
1986				
4Q	520	490	475	470
3Q	480	460	445	440
2Q	450	420	395	390
1Q	415	380	350	345
1985				
4Q	380/390*	355*	330	325*
3Q	380/390*	355*	330	325*
2Q	380/390*	365*	340	335*
1Q	420*	390*	370	365*
Year-end				
1984	485*	465*	—	430*
1983	430*	400	—	385*
1982	420*	390*	—	360*
1981	545	500*	—	455*
1980	545	530	—	505
1979	465/475	450	—	435
1978	380	360	—	350
1977	350*	330/340*	—	300/320*
1976	415*	410*	—	405*
1975	415	410	—	405
1974	370	—	—	—
1973	232	—	—	—
1972	185	—	—	—
1971	185	—	—	—
1970	180	—	—	—

* = Indicates some discounting from price levels shown.

NORDIC AND EUCALYPTUS PULP PRICES IN EUROPE

(Deutschemarks [DM] or US$/metric ton, c.i.f.)

Year	Northern bleached softwood kraft	Nordic birch	Bleached eucalyptus
1989			
4Q	DM1,630	DM1,520	DM1,505
3Q	DM1,630	DM1,520	DM1,505
2Q	DM1,530	DM1,440	DM1,440
1Q	DM1,430	DM1,340	DM1,340
1988			
4Q	DM1,430	DM1,340	DM1,340
3Q	DM1,315	DM1,240	DM1,240
2Q	DM1,250	DM1,190	DM1,190
1Q	DM1,180	DM1,130	DM1,130
1987			
4Q	DM1,180	DM1,130	DM1,075
3Q	DM1,125	DM1,075	DM1,075
2Q	DM1,125*	DM1,075	DM1,075
1Q	DM1,125*	DM1,075	DM1,075
1986			
4Q	DM1,100*	DM1,075	DM1,075
3Q	DM1,100*	DM1,025	DM1,025
2Q	DM1,080*	DM985	DM965/985
1Q	DM1,050*	DM910	DM900/$350
1985			
4Q	DM1,025*	DM875*	$330*
3Q	DM1,125	DM975*	$330*
2Q	DM1,200	DM1,075*	$340*
1Q	DM1,350	DM1,230*	$370*
Year-end			
1984	DM1,425*	DM1,325*	$435*
1983	$430*	$400	$390/400
1982	$420*	$390	$380*
1981	$545	$520	$480*
1980	$545	$520	$520
1979	$465/475	$450	$445
1978	$380	$360	$345
1977	$350	$325*	—
1976	$415	$405*	—
1975	$415	$405	—
1974	$370	$362	—
1973	$232	$220	—
1972	$185	$180	—
1971	$185	$180	—
1970	$180	$170	—

* = Indicates discounting. List prices shown for 1986-89.

Under price-fixing settlements reached with the European Economic Community, Nordic producers increasingly began to make sales in local currencies in the second half of 1984.

NORTH AMERICAN CHEMI-THERMOMECHANICAL PULP MILLS—EXISTING AND PROPOSED

Company	Location	Capacity (000 metric tpy)	Startup date
Quesnel	Quesnel River, B.C.	90 S[1]	1982
Temcell	Temiscaming, Que.	95 A/S	1986
Stone-Consolidated	Bathurst, N.B.	90 S[2]	1988
Cascades	Port Cartier, Que.	210 S	1988
Fibreco	Taylor, B.C.	180 S	1988
Quesnel	Quesnel River, B.C.	60 S[2]	1988
Millar Western	Whitecourt, Alta.	210 A/S	1988
Donohue-Matane	Matane, Que.	190 S	1990
Temcell	Temiscaming, Que.	150 A/S	1991
Alberta Energy	Slave Lake, Alta.	120 A	1991
Millar Western	Meadow Lake, Sask.	240 A/S	1992
Louisiana-Pacific	Chetwynd, B.C.	155 S	1992
Shinho	Thunder Bay, Ont.	150 A[3]	1992
Cascades	Cabano, Que.	115 A	1992
Fibreco	Taylor, B.C.	180 A	1993
Alcan	Vanderhoof, B.C.	220 A/S	n.a.
Taiwanese Paper Co.	Alberta	240 A/S	n.a.

A = aspen (hardwood); S = softwood (mainly spruce and some ledge-pole pine).
n.a. = Not available.

[1] Reflects about half of total capacity available for market sale; remainder mainly TMP shipped to Japanese partner.
[2] Reflects about half of total capacity available for market sale (mainly unbleached).
[3] Abitibi-Price to take about one-third of output.

Source: *Pulp & Paper Week.*

NORTH AMERICAN DISSOLVING PULP PRODUCERS ESTIMATED MILL CAPACITIES[1]

(000 metric tons)

Company	Prehydrolyzed sulfate pulp	Sulfite pulps	Cotton linters
ITT Rayonier			
Fernandina Beach, Fla.	—	150	—
Jesup, Ga.	350	—	—
Port Angeles, Wash.	—	155	—
Hoquiam, Wash.	—	—[2]	—
Buckeye Cellulose			
Foley, Fla.	180	—	—
Memphis, Tenn.	—	—	100
Alaska Lumber & Pulp			
Sitka, Alaska	—	190	—
International Paper			
Natchez, Miss.	220	—	—
Tembec Forest Products			
Temiscaming, Que.	—	160	—
Louisiana-Pacific			
Ketchikan, Alaska	—	125	—
Western Pulp			
Port Alice, B.C.	—	130	—
Weyerhaeuser			
Cosmopolis, Wash.	—	65	—
Alpha Cellulose			
Lumberton, N.C.	—	—	40
Southern Cellulose			
Chattanooga, Tenn.	—	—	30
Total	750	975	170

[1] Estimates of dissolving pulp capacity include some paper and fluff pulp. American Paper Institute and Canadian Pulp & Paper Assn. estimate U.S. dissolving pulp capacity at 1.270 million tons and Canadian capacity at 273,000 tons for a total of 1.54 million tons.
[2] Hoquiam mill has been supplying only slush pulp to adjacent Grays Harbor Paper Co. mill in recent years.

PLANNED CHANGES IN WORLD DISSOLVING PULP CAPACITY

(000 metric tons)

	Capacity			Total change		Average annual change (%)	
	1983	1988	1993	1983-88	1988-93	1983-88	1988-93
World total	6,102	5,145	5,324	-957	179	-3.4%	0.7%
Developed market economies	3,663	3,433	3,527	-230	94	-1.3	0.5
North America	1,656	1,548	1,524	-108	-24	-1.3	-0.3
Japan	449	325	325	-124	0	-6.3	0.0
Western Europe	1,118	1,140	1,258	22	118	0.4	2.0
Oceania	0	0	0	0	0	—	—
Others	440	420	420	-20	0	-0.9	0.0
Developing market economies	252	398	448	146	50	9.6	2.4
Africa	0	30	30	30	0	0.0	0.0
Latin America	57	98	98	41	0	11.4	0.0
Asia	195	270	320	75	50	6.7	3.5
Centrally planned economies	2,187	1,314	1,349	-873	35	-9.7	0.5
Asia	30	35	35	5	0	3.1	0.0
Eastern Europe	532	519	534	-13	15	-0.5	0.6
U.S.S.R.	1,625	760	780	-865	20	-14.1	0.5

Source: 1988 United Nations Food and Agriculture Organization survey, *Pulp and Paper Capacities.*

Fiber:

WASTEPAPER

Wastepaper is used as a lower-grade alternative to virgin pulp in the manufacture of paper and paperboard. Also referred to as paperstock, recyclable paper, and secondary fiber, it is not as widely used as woodpulp because of quality considerations. Successive repulping tends to lower the quality of the fiber, eventually making it unusable. Primary fibers are often added to maintain strength and other qualities.

The percentage of recyclable paper used in overall fiber furnish in the U.S. has not changed appreciably since 1970, when it was 21.5%. With only minor setbacks, it has continued on an upward trend and is expected to exceed 25% in 1989.

Wastepaper utilization—the ratio of secondary fiber used in proportion to total paper and paperboard produced—has also varied only slightly during more than two decades. Between 1965 and 1978, it remained at about 23%. After 1978, though, it crept past 24%, reaching 25.8% in 1987. It is expected to exceed 27% in 1989.

Aside from slight increases in utilization rates and ratios of usage in overall fiber furnish, the wastepaper market in 1988 was encouraged by record U.S. mill consumption of 20.069 million short tons.

International trade was also robust in 1988, with U.S. paperstock exports reaching a new high of 5.79 million short tons. However, the average dollar per ton of wastepaper exported fell during 1988 compared with 1987 for most grades. The exceptions were high-grade deinking stocks and a slight 0.3% rise in the price per ton of mixed paper. Major consuming countries in recent years have been Taiwan, Rep. Korea, Mexico, Japan, Canada, Italy, Spain, and India.

Total collection of recyclable paper in 1988 was 25.7 million tons, an increase from 1987 of 8.8% or 2.08 million tons.

The industry uses two main indicators of wastepaper consumption: the utilization rate and the ratio of wastepaper used to total fiber furnish. Utilization is calculated as a ratio of wastepaper consumed to total paper and paperboard produced. The utilization rate is slightly higher than the other figure due to the loss of fiber in papermaking.

Data on wastepaper consumption are collected by the Dept. of Commerce and American Paper Institute in the U.S. and by the Canadian government and Canadian Pulp & Paper Assn. in Canada. API figures are generally higher than those from the Dept. of Commerce because API includes inplant and intraplant use of paper machine trim and broke.

SUPPLY

The wastepaper industry collects material from many sources, sorts and segregates it into various types, and processes it for ease of handling, transport, and subsequent repulping. Balers and other costly equipment are required to perform these functions. The collection of wastepaper also provides important secondary services such as reduction of solid wastes and savings on garbage disposal costs.

Sources of paperstock are categorized generally as either pre- or postconsumer. Preconsumer generators of secondary fiber are primarily converting plants and printers. Converting plants produce recyclable products such as envelopes, books, and business forms. Printers are sources for materials such as magazines, directories, and catalogs. In these operations, waste is generated from machine trim as well as from other manufacturing operations. Postconsumer generators of waste include residential homes, factories, offices, and retail outlets.

In determining the supply of paperstock, industry experts watch the recovery rate. This is defined by API as the ratio of recyclable paper collected to new supply of paper and board. (New supply of paper and board equals production plus imports less exports, excluding hard pressed board. Imports and exports include paper and paperboard converted products.)

Overall, the recyclable recovery rate has been climbing for the past two decades, with minor setbacks along the way. It has hovered at about 26% since 1980, but that barrier was broken in 1986 when the rate reached 28%. This was due not only to a 13.3% rise in exports but also to a 7.4% increase in the amount of recyclable paper recovered.

ENVIRONMENTAL CONCERNS

An increasing amount of paper and paperboard is being recycled because of growing concern about the environment and because of the need to find alternate means of municipal waste disposal. In this decade, densely populated areas—particularly in the northeastern U.S.—have had to close down most of their landfills and look for other disposal methods.

For example, in New Jersey all but 20 of its landfills were closed by 1984, and no new ones were being constructed. In response to the crisis, the state in 1987 enacted a law requiring all communities to adopt mandatory recycling programs. Many states have followed New Jersey's lead by setting up their own recycling systems or by studying such programs. They include Minnesota, Massachusetts, New York, California, Connecticut, Florida, Georgia, Pennsylvania, Maryland, Virginia, Wisconsin, Illinois, District of Columbia, Louisiana, Vermont, Maryland, and Rhode Island.

The states have taken action because the Environmental Protection Agency has so far opposed congressional efforts to legislate source reduction. EPA prefers to rely on effecting a "cultural change" at the local level. It plans to award a small amount of grant money and technical assistance to states and municipalities to encourage recycling. EPA has set a national goal of 25% municipal solid waste recycling by 1992 and 50% by 2008. This program might be accelerated by Congress as it plans to reauthorize the Resource Conservation & Recovery Act.

COLLECTION SYSTEMS

Collection systems differ for the major categories of wastepaper. Old newspapers (ONP) used to be generated by residences and donated to nonprofit organizations during paper drives. With the spread of mandatory recycling efforts, however, many nonprofits have chosen other fundraisers because collecting ONP is no longer profitable. API reported that total collection of ONP in 1988 was 4.53 million short tons, an increase of 5.2% from 1987 and 31% from 1983. API estimated that the tonnage recovered in

WASTEPAPER UTILIZATION BY U.S. PAPER AND BOARD MILLS, BY GRADE

(000 short tons)

Year	Total	Mixed papers	%	News-papers	%	Corru-gated	%	Pulp sub-stitutes*	%	Deinking	%
1991e	23,025	2,471	10.7%	3,724	16.2%	11,571	50.3%	3,225	14.0%	2,033	8.8%
1990e	22,359	2,445	10.9	3,643	16.3	11,186	50.0	3,153	14.1	1,932	8.6
1989e	20,894	2,248	10.8	3,371	16.1	10,491	50.2	2,984	14.3	1,801	8.6
1988	20,069	2,180	10.8	3,527	17.6	9,747	48.6	2,999	14.9	1,615	8.0
1987	19,201	2,116	11.0	3,442	17.9	9,177	47.8	2,903	15.1	1,563	8.3
1986	18,128	2,045	11	3,118	17	8,634	48	2,761	15	1,570	9
1985	16,550	1,902	12	2,875	17	7,899	48	2,494	15	1,380	8
1984	16,883	1,975	12	2,895	17	7,972	47	2,673	16	1,369	8
1983	15,822	1,908	12	2,692	17	7,443	47	2,456	16	1,323	8
1982	14,620	1,707	12	2,673	18	6,770	46	2,247	15	1,224	8
1981	15,883	2,356	15	2,667	17	7,231	46	2,382	15	1,247	8
1980	15,094	2,268	15	2,564	17	6,866	45	2,254	15	1,142	8
1979	15,520	2,648	17	2,480	16	6,967	45	2,308	15	1,117	7
1978	14,760	2,729	18	2,212	15	6,721	45	2,242	15	1,068	7
1977	14,288	2,773	19	2,287	16	6,205	43	2,079	14	944	7
1976	13,822	2,798	20	2,278	17	5,696	41	2,117	15	933	7
1975	11,983	2,606	22	2,040	17	4,743	40	2,594*	22	—	—
1974	14,196	3,118	22	2,408	17	5,716	40	2,955*	21	—	—
1973	14,318	3,371	24	2,456	17	5,292	37	3,199*	22	—	—
1972	13,132	3,054	23	2,317	18	4,722	36	3,037*	23	—	—
1971	12,323	2,776	22	2,174	18	4,277	35	3,097*	25	—	—
1970	12,021	2,639	22	2,235	19	4,080	34	3,067*	25	—	—

* Pulp substitutes include deinking grades prior to 1976.
e = American Paper Institute estimate.

Source: American Paper Institute Capacity Survey for relevant years, 1970-91, and API data for recent years published in March 1989.

1988 was equal to 33% of the newsprint used in the U.S.

According to API statistics, ONP had these end uses in 1988: newsprint, 1.42 million tons; folding cartons, 1.307 million tons; sanitary tissue, 214,000 tons; and about 600,000 tons for other uses, such as construction paper and board, cellulosic insulation, molded egg cartons, cushioning materials for packaging, and animal bedding. API predicted that recycling of ONP will continue to grow during the 1990s above the rate of U.S. newsprint consumption.

Old corrugated containers (OCC) are obtained mostly from retail stores, factories, and office buildings. Only about 25% is supplied by postconsumer sources. Corrugated collections in 1988 totaled 12.0 million short tons, about 8% above the previous year. Of the total, about 2.5 million tons were box plant clippings (new double-lined kraft corrugated clippings), and 9.5 million tons were used containers. The 1988 collection rate was about 45%—the same level as in 1987.

UTILIZATION OF WASTEPAPER BY U.S. PAPER/BOARD MILLS

(000 short tons)

Year	Wastepaper used*	Paper/board produced	Utilization rate (%)
1991e	23,025	n.a.	n.a.
1990e	22,359	n.a.	n.a.
1989e	20,894	76,994	27.1%
1988	20,069	76,705	26.2
1987	19,201	74,435	25.8
1986	18,128	72,489	25.0
1985	16,550	68,658**	24.1
1984	16,883	70,268**	24.0
1983	15,822	66,764**	23.7
1982	14,620	60,962**	24.0
1981	15,883	64,259	24.7
1980	15,094	63,537	23.8
1979	15,520	64,345	24.1
1978	14,760	62,047	23.8
1977	14,288	60,040	23.8
1976	13,822	58,329	23.7
1975	11,983	50,976	23.5
1974	14,196	59,040	24.0
1973	14,318	59,900	23.9
1972	13,132	57,433	22.9
1971	12,323	53,162	23.2
1970	12,021	51,671	23.3

e = Estimate.
n.a. = Not available.
* Includes the following tonnage consumed in the manufacture of molded pulp products: 1982, 187,000 tons; 1983, 174,000 tons; 1984, 157,000 tons; 1985, 179,000 tons; 1986, 191,000 tons; 1987-89, 202,000 tons.
** Includes the following tonnages for construction and wet machine board grades: 1982, 1,662,000 tons; 1983, 1,800,000 tons; 1984, 1,800,000 tons; 1985, 1,800,000 tons.

Sources: Wastepaper utilization from American Paper Institute Capacity Survey for relevant years. Production totals from API "Statistics of Paper, Paperboard & Wood Pulp" and from "Paper, Paperboard & Wood Pulp Monthly Statistical Survey."

Mixed papers are generated mostly in office buildings and are collected by private haulers. When demand is poor and prices fall, haulers usually cease picking up mixed papers because, as the cheapest of wastepaper grades, their price drops below a level that makes collection profitable.

Collection of mixed papers totaled 3.1 million short tons in 1988, an increase of 7.4% from 1987. Export demand in 1988 jumped 20% from 1987 to 150,000 tons.

High grades of wastepaper are usually obtained from large office buildings, where an agreement is worked out with a paperstock dealer. More corporations and commercial landlords are collecting office papers to reduce their waste disposal costs and to make some additional money from selling the refuse. Usually this is done by having employees sort their own office discards and take them to a central collection point in the building, where the refuse is subsequently picked up by a private hauler.

Total collection of high grades for deinking and pulp substitutes in 1988 was 6.1 million short tons, up 13% from the previous year. This reflected the increasing yield of clippings from factories making paper products such as envelopes, business forms, and printed brochures. Demand for the high grades was also good as mills shifted more of their fiber furnish requirements from woodpulp to secondary fiber.

U.S. WASTEPAPER DOMESTIC UTILIZATION AND EXPORTS

(000 short tons)

Year	Used	Exported	Total	Exports as percent of total
1988	20,069	5,640	25,709	22%
1987	19,201	4,418	23,623	19
1986	18,128	3,724	21,636	17
1985	16,550	3,283	19,657	17
1984	16,883	3,268	19,959	16
1983	15,822	2,393	18,212	13
1982	14,620	2,127	16,560	13
1981	15,883	2,213	17,659	13
1980	15,094	2,664	17,972	15
1979	15,520	2,233	17,594	13
1978	14,760	1,599	16,359	10
1977	14,288	1,512	15,570	10
1976	13,822	1,273	14,895	9
1975	11,983	861	12,843	7
1974	14,196	1,307	15,289	9
1973	14,318	683	14,777	5
1972	13,132	415	13,340	3
1971	12,323	419	12,525	3
1970	12,021	408	12,211	3

Sources: American Paper Institute Capacity Survey; Dept. of Commerce.

GRADES

Mixed papers, news, old corrugated containers, pulp substitutes, and deinking are the five official grade categories used by the Dept. of Commerce and generally accepted by the industry as key benchmarks for numerous other grades.

The Paper Stock Institute subdivides the five classifications into more definitive grades. These include 49 regular grades that comprise the bulk of the wastepaper traded in the U.S. and Canada, along with 31 specialty grades that are sold to a limited number of mills able to use them in their product mixes. The latter grades generally include contaminants, such as plastic coatings and foil, which restrict their use.

Grade characteristics:

- Mixed paper: paper of varied quality, often office waste; also boxboard cuttings and mill wrappers.
- News: old newspapers, either collected from households or over-issues at newsstands or inplant; also groundwood paper trim.
- Old corrugated containers: used corrugated containers; also container plant cuttings.
- Pulp substitutes: unprinted grades of brown and colored kraft, white and semibleached sheets and cuttings, tabulating cards, and shavings or trim of unprinted grades.
- Deinking: deinking grades of white and colored ledger, computer printout (CPO), coated book and groundwood paper, and bleached sulfate sheets and cuttings.

MARKETS

Markets for the various grade classifications of wastepaper are essentially different, although there is some crossover in the types of paper and board made from different furnishes. For example, clay-coated newsback can incorporate OCC, ONP, and pulp substitutes.

Mixed papers, the cheapest grade of paperstock, are used in construction paper and board products such as roofing felts and gypsum wallboard. A shift from paper-based roofing to fiberglass-based shingles has cut demand substantially for mixed papers in this market. However, an increase in housing starts in 1988 boosted demand for mixed papers in gypsum wallboard production. Housing starts in 1989 are expected to drop to the 1.35 million level.

Demand for OCC, mainly from linerboard and corrugating medium mills, has risen dramatically in recent years. This caused prices in many markets to at least double by mid-1987, compared with the levels of mid-1985. On the West Coast, for instance, mills paid premiums as high as $100/short ton f.o.b. seller's dock. However, a comparison of OCC prices from fourth-quarter 1988 and fourth-quarter 1987 shows that the price of OCC declined by 20.0% in the New York City area, 30.8% in the Midwest, 44.1% in the Southeast, and 39.5% on the West Coast. This indicates that prices may have peaked in 1987, because prices during the first half of 1989 were nowhere near these levels.

The ONP market is in a shambles because of supply gluts in areas with mandatory collection laws. A comparison of prices from fourth-quarter 1988 and fourth-quarter 1987 shows that the price of ONP fell 36.4% in the New York City area, 44.6% in the Midwest, 27.1% in the Southeast, and 40% on the West Coast. The situation deteriorated further in 1989, with some municipalities in the Northeast paying mills to take ONP off their hands. The transaction price is hard to determine because mills often keep prices at artificially inflated levels so that those who make a living packing and sorting ONP can stay in business. Because of the overabundance of ONP, the real market value of this post-consumer paperstock is zero.

High grades tend to suffer least during fluctuations in market conditions. With the inexorable increase in market pulp prices during 1987-88, many mills stepped up their use of pulp substitutes such as hard white envelope cuttings and hard white shavings (HWS). When the price of pulp substitutes became too high, mills that could traded down to deinking grades such as CPO, manifold white ledger, and manifold colored ledger.

In contrast to OCC, ONP, and new double-lined kraft corrugated clippings, the price of pulp substitutes and deinking grades rose in 1988. Compared with the same period a year earlier, the fourth-quarter price of HWS rose 12.9% in New York City, 18% in the Midwest, 15.1% in the Southeast, and 6.8% on the West Coast.

The fourth-quarter 1988 price of CPO in the same areas

WASTEPAPER AS PERCENT OF FIBER FURNISH IN U.S. PAPER/BOARD PRODUCTION

(000 short tons)

Year	Wastepaper	Total woodpulp, other fibers	Percent of wastepaper
1989p	20,894	61,724	25.3%
1988	20,069	61,161	24.7
1987	19,201	59,552	24.4
1986	18,128	55,582	24.6
1985	16,550	53,308	23.7
1984	16,883	55,174	23.3
1983	15,822	51,834	23.2
1982	14,620	48,440	23.2
1981	15,217	51,764	22.7
1980	15,094	51,028	22.8
1979	15,400	51,303	23.1
1978	14,760	54,074	21.5
1977	14,288	49,799	22.3
1976	13,822	48,082	22.3
1975	11,983	43,104	21.8
1974	14,196	49,130	22.4
1973	14,318	49,558	22.4
1972	13,132	48,032	21.5
1971	12,323	44,805	21.5
1970	12,021	43,802	21.5

p = Preliminary.
Calculated by *Pulp & Paper* from American Paper Institute data.

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

NO. 6 NEWS

	NYC	Chicago	Atlanta	SF-LA
1988				
4Q	$35.00	$30.00	$35.83	$45.00
3Q	45.83	42.50	52.50	59.16
2Q	50.00	44.16	52.50	68.33
1Q	58.30	55.00	54.16	78.33
1987				
4Q	55.00	54.17	49.17	75.00
3Q	44.16	40.83	38.33	75.00
2Q	47.50	42.50	40.83	71.66
1Q	40.00	37.50	42.50	65.83
1986				
4Q	25.00	24.16	30.00	40.00
3Q	31.67	32.50	41.67	46.67
2Q	35.00	30.83	35.00	45.00
1Q	30.00	22.50	37.50	48.12
Year-end				
1985	25.00	22.50	30.00	40.00
1984	42.50	47.50	42.50	45.00
1983	42.50	47.50	47.50	51.25
1982	30.00	37.50	32.50	45.00
1981	27.50	22.50	32.50	30.00
1980	45.00	50.00	57.00	53.50

OLD CORRUGATED CONTAINERS

	NYC	Chicago	Atlanta	SF-LA
1988				
4Q	$43.33	$37.50	$39.16	$60.00
3Q	55.83	45.83	60.00	76.66
2Q	51.66	42.50	50.00	82.50
1Q	52.50	47.50	49.17	92.50
1987				
4Q	54.17	54.17	70.00	99.17
3Q	71.66	70.00	76.66	104.16
2Q	47.50	42.50	40.83	71.66
1Q	40.00	37.50	42.50	65.83
1986				
4Q	22.50	25.00	32.50	46.66
3Q	45.83	50.83	55.00	77.50
2Q	33.33	36.67	35.83	55.00
1Q	25.00	26.66	32.50	46.25
Year-end				
1985	22.50	25.00	32.50	60.00
1984	37.50	46.25	50.00	50.00
1983	47.50	60.00	67.50	70.00
1982	30.00	30.00	37.50	32.50
1981	27.50	33.50	34.50	40.00
1980	33.00	44.00	43.00	57.00

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.

Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

NEW DOUBLE-LINED KRAFT CORRUGATED CLIPPINGS

	NYC	Chicago	Atlanta	SF-LA
1988				
4Q	$69.16	$67.50	$75.83	$109.16
3Q	93.33	94.16	95.83	124.16
2Q	90.83	92.50	97.50	125.83
1Q	99.16	102.50	107.50	134.16
1987				
4Q	83.33	95.83	97.50	135.00
3Q	105.00	110.00	107.50	151.66
2Q	97.50	98.33	97.83	150.00
1Q	82.50	82.50	85.83	130.83
1986				
4Q	42.50	38.33	52.50	75.83
3Q	81.67	87.50	90.83	103.33
2Q	65.00	65.00	60.83	80.00
1Q	50.83	46.66	54.16	76.66
Year-end				
1985	42.50	37.50	52.50	77.50
1984	77.50	83.75	77.50	92.50
1983	72.50	77.50	82.50	100.00
1982	45.00	47.50	47.50	70.00
1981	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.

HARD WHITE SHAVINGS

	NYC	Chicago	Atlanta	SF-LA
1988				
4Q	$335.00	$363.33	$355.00	$368.33
3Q	343.33	365.00	353.33	360.00
2Q	323.33	341.66	340.00	335.00
1Q	320.00	331.66	336.66	345.00
1987				
4Q	296.66	306.66	308.33	345.00
3Q	276.66	275.00	393.33	323.33
2Q	276.66	266.66	293.33	321.66
1Q	285.83	285.00	291.66	316.66
1986				
4Q	180.00	145.00	160.00	188.33
3Q	248.33	226.67	218.33	253.33
2Q	210.00	185.00	188.33	220.83
1Q	187.50	151.66	166.66	195.00
Year-end				
1985	180.00	145.00	160.00	190.00
1984	245.00	205.00	240.00	245.00
1983	212.50	215.00	210.00	195.00
1982	200.00	195.00	190.00	180.00
1981	252.50	231.00	232.50	237.50
1980	251.50	278.50	260.00	269.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
n.a. = Not available.

Source: *Pulp & Paper Week.*

rose 10.4%, 23.0%, 17.2%, and 8.4%, respectively. The problem many mills face with CPO is the increasing use of laser printers in offices. Laser printers burn ink into the paper, and conventional flotation and chemical processes do not remove it. Some companies claim to have developed methods for dealing with laser-printed CPO, but they are very secretive with the details. Kimberly-Clark Corp. operates a pilot plant for this purpose at its tissue mill in Memphis, Tenn., but the company will not discuss the project. Industry sources believe Fort Howard Corp. also has such technology in place.

Unlike in other sectors of the pulp, paper, and paperboard industry, the consumer of wastepaper usually sets the price. When mills want to generate more paperstock due to projected shortfalls in supplies, they raise prices and cause generators to take interest in the market again. Conversely, prices are cut when the intention is to slow the flow.

The exception occurs during a shortage, when demand picks up faster than additional supplies can be generated. This does not happen often, however, as mills have become increasingly more adept at spotting upcoming changes in

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

MANIFOLD COLORED LEDGER

	NYC	Chicago	Atlanta	SF-LA
1988				
4Q	$119.16	$150.00	$138.33	$159.16
3Q	125.00	160.00	150.83	173.33
2Q	125.00	153.33	149.16	165.83
1Q	122.50	146.66	138.33	128.33
1987				
4Q	112.50	137.50	118.33	110.83
3Q	90.83	121.66	111.66	107.50
2Q	85.83	106.66	91.66	107.50
1Q	78.33	90.00	90.00	102.50
1986				
4Q	79.16	80.00	73.33	70.00
3Q	88.33	81.67	85.00	72.50
2Q	72.50	81.67	77.50	77.50
1Q	72.50	80.00	72.50	68.33
Year-end				
1985	72.50	80.00	70.00	70.00
1984	115.00	125.00	120.00	117.50
1983	112.50	105.00	90.00	65.00
1982	67.50	90.00	85.00	55.00
1981	110.00	112.50	107.50	115.00
1980	127.50	122.50	127.50	127.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.

Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

COMPUTER PRINTOUT (No. 42)

	NYC	Chicago	Atlanta	SF/LA
1988				
4Q	$213.33	$205.00	$273.33	$301.66
3Q	236.66	215.00	290.00	326.66
2Q	230.00	205.00	285.00	301.66
1Q	221.66	191.66	269.16	296.66
1987				
4Q	193.33	166.66	233.33	278.33
3Q	185.00	165.00	215.00	245.00
2Q	185.00	165.00	200.00	235.00
1Q	175.00	165.00	186.66	231.66
1986				
4Q	135.00	126.66	140.83	166.66
3Q	169.17	180.00	192.50	228.33
2Q	143.33	130.00	175.00	209.17
1Q	135.00	125.00	144.16	180.00
Year-end				
1985	135.00	125.00	142.50	170.00
1984	205.00	170.00	205.00	245.00
1983	172.50	160.00	155.00	190.00
1982	170.00	145.00	155.00	192.50
1981	177.50	203.50	183.50	178.50
1980	175.50	195.00	158.50	199.00
MANIFOLD WHITE LEDGER				
1988				
4Q	$170.83	$186.66	$193.33	$202.50
3Q	181.66	205.00	233.33	215.00
2Q	176.66	194.16	200.00	200.83
1Q	170.00	183.33	183.33	198.33
1987				
4Q	155.00	165.00	167.50	195.00
3Q	141.66	151.66	158.33	175.00
2Q	133.33	136.66	141.66	168.33
1Q	115.83	116.66	127.50	155.00
1986				
4Q	99.16	94.16	95.00	100.00
3Q	114.17	103.33	91.67	118.33
2Q	92.50	93.00	90.00	97.50
1Q	94.16	92.50	90.00	92.50
Year-end				
1985	92.50	92.50	90.00	100.00
1984	146.25	145.00	140.00	147.50
1983	132.50	125.00	109.50	120.00
1982	90.00	100.00	95.00	105.00
1981	137.50	128.50	131.00	146.00
1980	136.50	151.50	140.50	160.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.

Source: *Pulp & Paper Week.*

the marketplace. In addition, more primary producers are themselves getting involved in recycling, integrating their operations fully or partially to eliminate or reduce the need for a middleman such as a dealer or broker of paperstock.

Secondary fiber prices react quickly to changes in the entire industry, and they are considered a bellwether of future market conditions. Most industry experts think wastepaper prices will continue to vacillate suddenly and sharply unless supplies are substantially reduced by construction of waste-to-energy facilities throughout the country or by other methods that would limit supplies.

EXPORTS/IMPORTS

The U.S. is by far the world's largest exporter of wastepaper. In 1988, U.S. paperstock exports reached an all-time high of 5.64 million short tons—a 27.5% increase over 1987. Export records were set for all grades of paperstock except mixed papers.

The largest consumers of U.S. paperstock in 1988 were Rep. Korea, 1.225 million short tons; Mexico, 1.133 million tons; Taiwan, 991,497 tons; and Japan, 607,787 tons.

U.S. wastepaper exports have grown rapidly during the past two decades, rising from 408,000 short tons in 1970. Aside from the record reached in 1986, each of the years after 1982 marked all-time highs. In 1982, however, exports dipped 3.8% due to a worldwide recession, but they jumped 12.5% in 1983 to 2.393 million short tons.

The U.S. paper industry imported a meager 146,059 tons of wastepaper in 1988, and 97% of this came from Canada. Import levels have varied up and down over the past two decades. In 1977, for example, U.S. mills imported 106,444 short tons. This dipped to 91,013 tons in 1978 and 69,719 tons in 1979. Imports again rose to 109,712 tons in 1984.

Around May 1989, the U.S. dollar began to strengthen as export markets began to weaken. A longshoremen's strike in Italy curtailed shipments to some ports in that country for several months in 1989, while a strike at a mill in Rep. Korea forced some exporters to divert shipments to Taiwan. The unrest in People's Rep. China during the spring of 1989 did not hurt U.S. exporters too much because sales to that country have never been substantial. People's Rep. China buys mostly occ and not too much ONP because it has very few deinking lines.

Throughout 1988 and into 1989, wastepaper exporters had difficulty getting containers. Some brokers on the East Coast even had to turn down business because they could not obtain them. Part of the problem was that containers were sitting in the Far East while shipping companies waited for imports to take back to the U.S. Some wastepaper dealers on the West Coast alleged that steamship companies were sending ships east at less than full capacity to keep freight rates artificially inflated. Wastepaper exporters have long complained about the treatment they receive from steamship companies, which would rather fill their vessels with more expensive cargo in order to get a better rate. Unless they have a longstanding relationship with a shipping company, wastepaper exporters are the first to lose out when containers are in short supply.

CANADA'S TRADE AND USE

Canada remains one of the top five export customers for U.S. paperstock, but its ranking has dropped from second to fifth place since 1980. It is still the chief supplier of U.S. imported wastepaper; however, the import market meets less than 1% of U.S. mills' secondary fiber requirements. Canada, on the other hand, represents 5.9% of the export market for U.S. paperstock. The U.S. exported 331,999 short tons of wastepaper to Canada in 1988.

Canadian mills have increased their use of wastepaper. Canadian recyclable paper consumption rose steadily between 1975 and 1987 to 1.695 million metric tons, according-

U.S. WASTEPAPER EXPORTS TO MAJOR CONSUMING COUNTRIES (1988)

(short tons)

Country	Printed news	High-grade deinking	High-grade pulp substitutes	Corrugated	Mixed	Total	Percent of market
Rep. Korea	309,278	298,463	64,878	346,275	206,798	1,225,692	21.73%
Mexico	316,602	65,354	371,665	367,330	12,157	1,133,108	20.09
Taiwan	177,888	111,044	56,584	457,558	188,423	991,497	17.58
Japan	43,478	75,455	35,017	309,561	144,276	607,787	10.77
Canada	10,750	35,088	58,894	146,543	80,724	331,999	5.88
Italy	10,652	37,336	1,424	158,389	61,540	269,341	4.77
Spain	6,507	33,607	3,218	114,689	11,610	169,631	3.00
Philippines	10,940	37,388	17,904	12,399	21,470	100,101	1.77
Total exports	1,008,664	841,696	627,757	2,277,166	884,835	5,640,118	100.00

Source: Dept. of Commerce as reported by the American Paper Institute.

ing to CPPA. Of this amount, 905,058 tons were container grades, 363,282 tons were pulp substitutes and other grades, 239,024 tons were news grades, 121,073 tons were mixed papers, and 67,227 tons were boxboard cuttings.

Canada has only one mill that makes recycled newsprint—Quebec & Ontario Paper Co.'s mill in Thorold, Ont., which makes newsprint with 50% recycled content. Atlantic Packaging Products Ltd. in Whitby, Ont., is slated to bring onstream a new 150,000-metric-tpy 100% recycled newsprint machine in July 1990. It also plans to start up a 43,000-short-tpy recycled tissue machine there in fall 1989. In April 1989, Noranda Forest Inc. said it was studying the addition of a C$45- to $55-million deinking line for its Fraser Inc. fine papers mill in Thorold, Ont.

While Canadian citizens eagerly participate in residential recycling programs, the Canadian newsprint industry, which is based on virgin pulp, will not be able to use more ONP without a substantial investment in new equipment.

PULPING

Pulping wastepaper is significantly easier than pulping wood. The process involves the separation of the web or sheet into individual fibers. The removal of any ink is considered a separate process and is called deinking.

A pulper is generally used in pulping secondary fiber. It is filled with water, and wastepaper is added, usually from a conveyor belt, until a consistency of at least 5% to 6% recyclable paper is reached. A spinning rotor in the bottom of the pulper tears the paper into smaller pieces. These pieces, in turn, rub against each other to further break down the fibers. Stock removed from the pulper usually passes through a screen to remove pieces that have not been broken down sufficiently.

Chemically treated or coated wastepaper, which may be more difficult to repulp, requires further processing. Usually the water in the pulper is heated to 65°C (150°F), and chemicals such as sodium hydroxide or soaps and dispersing agents are added.

In the deinking operation, washing equipment and special chemicals lift ink from the paper. Some wastepaper is difficult or impossible to deink economically because of plastics or pressure-sensitive adhesives in the paper.

As laser printing has become more widespread in recent years, so too has the problem of removing ink that is burned into paper. The cost of deinking, in some cases, can approach the cost of buying virgin fiber in a weak market, thus pricing grades such as CPO out of the market. The alternative is to switch to cleaner but often more costly grades.

The U.S. generates about 160 million tpy of municipal solid waste, and about 84% of all municipal solid waste is disposed of in landfills. About 75% of these landfills will close within the next 15 years. By the year 2000, the U.S. will be short 56 million tpy of disposal capacity, according to attorney William L. Kovacs of the law firm Eckert Seamans Cherin & Mellott in Washington, D.C. Because wastepaper accounts for almost half of all solid waste, the paper industry will inevitably be involved in efforts to recycle more of it.

A fundamental misconception on the part of many citizens and public officials is that mandatory collecting and sorting of wastepaper equals recycling. Recycled paper mills in the U.S. already use as much wastepaper as they can. Until the public demands more recycled paper, these mills have no incentive to install more capacity. This leaves municipalities with tons of ONP on their hands.

On the East Coast, mills are paid to take ONP. Some recycling centers have shut down because they can no longer

U.S. WASTEPAPER EXPORTS, 1970-88

(short tons)

	News	Corrugated	High-grade deinking	High-grade pulp substitutes	Other	Total
1988	1,008,664	2,277,166	841,696	627,757	884,835	5,640,118
1987	869,743	1,920,719	525,860	365,419	736,691	4,418,432
1986	765,832	1,524,897	446,966	312,239	674,940	3,724,874
1985	624,644	1,310,852	290,486	178,975	879,042	3,283,999
1984	540,459	1,263,043	296,274	251,200	917,201	3,268,177
1983	461,153	993,436	224,701	189,578	750,463	2,393,381
1982	444,093	886,655	140,349	163,790	492,131	2,127,018
1981	425,060	991,115	130,319	192,192	473,863	2,212,549
1980	424,864	1,208,609	176,442	204,881	649,395	2,664,191
1979	336,138	960,369	134,959	153,950	647,686	2,233,102
1978	366,005	576,653	93,307	92,452	471,032	1,599,449
1977	644,038	591,529	301,273[1]	—	341,526	1,878,366[2]
1976	244,118	426,104	300,096[1]	—	302,418	1,272,626
1975	164,294	333,631	176,145[1]	—	187,318	861,388
1974[3]	—	—	—	—	—	1,307,000
1973[3]	—	—	—	—	—	683,444
1972[3]	—	—	—	—	—	415,033
1971[3]	—	—	—	—	—	419,046
1970[3]	—	—	—	—	—	408,000

1. Includes "high-grade pulp substitutes."
2. Subsequent revision by Census changed total to 1,544,000 tons, due to errors reported in exports to Greece and Canada; revision does not indicate which wastepaper grades are affected by the change.
3. No grade designations prior to 1975.

Source: Dept. of Commerce data as reported by the American Paper Institute.

make a profit. For example, the main recycler in the Twin Cities area of Minnesota closed in May 1989 because, within an eight-day period, it went from selling 1,800 tons/month of ONP to paying over $5,000/day to dispose of the paper.

In order to stimulate demand for ONP, some states tax newspapers that do not use some recycled newsprint (see Newsprint chapter). In addition, states and municipalities are enacting laws that require their purchasing agents to procure paper that contains a certain percentage of recycled fiber content.

In June 1989, the federal government became lawfully required to buy recycled paper under Section 6002 of the Resource Conservation & Recovery Act. On June 14, the Government Printing Office accepted its first bid for printing/writing paper specifying recovered material content.

The law states that all agencies of the federal government must implement a preference purchasing program favoring recycled items. This applies to state and local government agencies funded by the federal government that buy $10,000 or more of the designated grades.

The paper procurement guideline was established by EPA and applies to 24 paper and board grades. For example, newsprint must contain at least 40% postconsumer wastepaper. Offset printing paper, envelopes, mimeograph and duplicating paper, ledger, bond, book paper, and stationery must contain 50% recycled wastepaper. Toilet tissue must contain 20% postconsumer wastepaper, towels must contain 40%, and corrugated cartons must contain 35%. Information on the federal procurement program can be obtained from the EPA procurement guidelines hotline at (703) 941-4452.

The Canadian government is trying to stimulate demand for recycled paper products through its Environmentally Friendly Products Program, started in October 1988. Canada has no federal mandatory procurement law. Instead, it has started the voluntary program that identifies products that are qualified to display an "environmentally friendly" label. A poll conducted in Canada showed that Canadian consumers are willing to pay more for such a product in order to protect the environment. One of the first products to be listed under the program was insulation material made from recycled paper.

More businesses in both the U.S. and Canada are recycling their office waste. These wastepaper grades, like CPO paper and ledger grades, bring a higher price on the market than ONP. The Office of Paper Recycling Services in New York City estimates that the average office worker produces at least 1 lb/day of wastepaper. In early 1989, API estimated that corporations in the U.S. recycle about 200,000 tpy of paper compared with virtually nothing ten years ago. Some corporations find that they save money on their trash bill by having recycling plants haul away their paper trash. Paper generated by offices is cleaner than that of homes, and it is more desirable to packers, who compete for the right to haul away wastepaper from big office buildings.

During May 14-15, 1990, *Pulp & Paper* magazine will sponsor a conference on mandatory recycling legislation and its effects on the markets for major paper and board grades. For more information about the conference, contact Laurie Mansur at Miller Freeman Publications. Phone: (415) 995-2471.

U.S. WASTEPAPER EXPORTS—AVERAGE DOLLAR PER SHORT TON (1988)

	East Coast	Great Lakes	Gulf Coast	West Coast	Total U.S.
Corrugated	$101.48	$79.81	$117.47	$117.22	$108.83
% change*	-12.0%	-7.2%	-0.8%	-13.4%	-10.3%
Printed news	68.37	76.15	93.39	87.77	86.73
% change*	-14.2	-3.7	23.5	-10.0	-2.9
High-grade deinking	161.37	169.49	215.87	175.84	174.99
% change*	13.7	17.6	12.4	4.5	9.0
Pulp substitutes	187.54	143.02	155.37	177.31	162.24
% change*	-10.7	-5.4	-22.2	-9.5	-17.1
Mixed	111.07	121.68	162.94	114.47	117.33
% change*	5.1	-21.6	9.4	-2.1	0.3
Total	110.86	111.14	130.30	126.56	122.03
% change*	-4.6	2.8	-0.3	-2.7	-2.5

* = From 1987.

Source: Dept. of Commerce.

CONVERTED PAPER AND BOARD PRODUCTS

The converting sector produces finished products—corrugated boxes, folding cartons, envelopes, and facial tissue—from paper and paperboard. The average converting plant is small, usually employing fewer than 100 persons and annually grossing about $10 million or less. However, the total converting sector of the industry is not small. In fact, when sales of all converting segments are combined, they nearly equal the total value of all paper and board manufactured.

Because the converting sector is large and complex, this chapter describes the subject only in a general way. In many cases, it is more practical to discuss converting under the primary manufacturing to which it relates; therefore, the reader is referred to sections covering primary paper or board grades for additional information.

The following converted paper and board products are discussed here or in other specified sections:

- Corrugated containers and solid fiber boxes (refer to Linerboard and Corrugating Medium sections)
- Setup paperboard boxes (Recycled Paperboard section)
- Fiber and composite cans, tubes, and drums (Recycled Paperboard section)
- Folding boxboard (Recycled Paperboard section)
- Sanitary food containers (Bleached Board section)
- Molded pulp products (Molded Pulp Products section)
- Bags and sacks (Packaging and Industrial Converting Papers section).

The following converted products, though not discussed in the text, are included in the statistical data in this section:

- Die-cut paperboard
- Paper coating and glazing
- Envelopes
- Stationery products
- Converted paper products, not classified.

While the printing and publishing industries are not converting industries, they are closely allied to the paper industry; data on these industries are summarized in the introduction to the Paper Grades section.

CORRUGATED CONTAINERS

Corrugated containers are the workhorses of the packaging industry. More goods and products are shipped in corrugated containers than in any other packaging system. Nearly 90% of industrial and consumer goods transported in the U.S. are shipped in some form of corrugated or solid-fiber container, cushioning, or partition.

Corrugated containers are produced from two paperboard grades—linerboard and corrugating medium. Corrugated board is produced on a corrugator that simultaneously flutes the corrugating medium and bonds linerboard to the

PACKAGING SALES BY PACKAGING MATERIALS FOR 1987

	Shipments (billion $)	% of total
Total packaging sales	$53.7	100.0%
Paper and paperboard	27.3	50.8
Corrugated containers	15.6	29.1
Folding cartons	5.5	10.2
Paper bag/sacks	2.3	4.3
Sanitary food containers	1.9	3.5
Others	2.0	3.7
Metal	11.3	21.1
Cans	10.3	19.2
Drums and others	1.0	1.9
Other materials	15.1	28.1
Glass	4.5	8.4
Flexible	4.0	7.4
Plastic	3.8	7.1
Wood and textile	0.8	1.5
Others	2.0	3.7

Source: Bureau of the Census.

top and bottom of the medium. The corrugator also cuts the board to size and may score it in one direction. Before the blank can be formed into a box, score lines must be added in the other direction, and slots must be cut to form flaps that can be folded. Promotional information, specifications, and handling instructions must also be printed. The machine that most often performs these multiple steps is a flexo-slotter-folder-gluer.

The most common form of corrugated board is single wall (one layer of medium between two layers of linerboard). About 90% of boxes in the U.S. are made from single-wall board. Corrugators can also produce single face

U.S. CONVERTED PRODUCTS INDUSTRY VALUE OF SHIPMENTS

(million $)

CONVERTED PAPER PRODUCTS

Year	Total	Sanitary paper products[1]	Bags and sacks[2]	Paper coating, glazing	Die-cut paper and board	Miscellaneous converted products[3]	Envelopes	Stationery and tablets	Pressed and molded pulps
1987	$35,550	$11,593	$7,123	$7,334	$1,739	$3,672	$2,620	$1,229	$240
1986	32,248	10,965	5,954	6,632	1,939	3,082	2,270	1,168	238
1985	30,710	10,338	5,614	6,340	1,890	2,994	2,172	1,128	234
1984	29,925	9,772	5,388	6,452	1,880	2,928	2,108	1,161	236
1983	26,563	8,616	5,081	5,314	1,798	2,604	1,875	1,058	217
1982	25,044	8,374	4,773	4,903	1,605	2,436	1,752	959	242
1981	26,111	8,346	5,613	5,146	1,677	2,598	1,601	892	238
1980	23,705	7,636	5,215	4,688	1,454	2,187	1,464	836	225
1979	21,081	6,615	4,579	4,086	1,468	2,043	1,304	766	220
1978	18,447	5,591	3,926	3,746	1,189	1,901	1,121	747	226
1977	16,454	4,921	3,482	3,392	1,058	1,698	991	652	240
1976	12,558	4,187	1,936	2,653	983	1,267	843	510	219
1975	11,086	3,647	1,760	2,198	882	1,107	806	483	203
1974	9,886	3,041	1,913	2,350	884	1,073	813	486	202
1972	7,297	1,982	1,186	1,650	646	662	558	421	162

BOXES AND CONTAINERS

Year	Total	Corrugated containers[4]	Folding boxboard	Sanitary food containers	Fiber cans, tubes, drums	Setup paperboard boxes
1987	$25,904	$16,073	$5,687	$2,193	$1,517	$434
1986	22,929	13,335	4,466	2,982	1,615	531
1985	21,926	12,579	4,347	2,847	1,640	513
1984	21,968	12,719	4,327	2,750	1,679	493
1983	19,906	11,045	3,980	2,686	1,643	552
1982	18,578	10,303	3,744	2,556	1,490	485
1981	18,917	10,760	3,557	2,691	1,496	413
1980	17,193	9,651	3,277	2,430	1,370	465
1979	15,895	8,976	2,950	2,328	1,297	434
1978	14,528	8,030	2,884	2,086	1,119	409
1977	13,350	7,351	2,579	2,048	1,011	361
1976	11,662	6,530	2,162	1,744	1,000	406
1975	10,476	5,733	1,875	1,616	988	344
1974	10,489	5,867	1,807	1,506	909	400
1972	7,913	4,197	1,372	1,381	620	343

1. Includes drapes, sanitary napkins, tampons.
2. Includes plastic bags and sacks.
3. Includes wallcovering, gift wrap, industrial products, novelty items, etc.
4. Includes solid-fiber containers.

Source: Bureau of the Census.

(one layer of medium bonded to a single layer of liner), which is used mainly for wrapping and interior packing. Heavier-duty boxes can be made from double wall (two layers of medium and three linerboard facings) and triple wall (three medium layers and four liner facings).

Flutes have five standard sizes—A, B, C, D, and E. Flute size is determined by the size of the corrugating roll's teeth, and is measured in flutes per linear feet. The larger flutes generally offer greater stacking strength, and the smaller flutes offer greater puncture resistance. Most converting plants produce the intermediate-size B- and C-flutes. A-flute is the largest, but it is not widely used. E-flute is the smallest, and is somewhat of a specialty because it can be run on folding carton equipment. It also offers the smoothest printing surface because its closely spaced flutes prevent "wash boarding" of the outer liner. Choice of flute type is dependent primarily on strength (crush strength) and packaging requirements.

Corrugated boxes are manufactured in several different styles, the most common of which is the regular slotted container. More specialized types of boxes include bag-in-box for liquids and powdered products, bulk bins that can carry products weighing up to 3,000 lb, and trays for produce. Solid-fiber boxes, the first fiber boxes to replace wood packaging, account for only about 0.4% of industry shipments. Solid-fiber sheets are constructed by gluing or laminating two or more plies of paperboard together. A new and growing solid-fiber application is slip sheets, which are replacing wooden pallets for forklift loads.

Freight classifications are guidelines that have been established by railroads and common motor carriers, and they include rules governing the acceptance of freight in transportation. Among other things, Railroad Rule 41 and Motor Carrier Item 222 establish (1) bursting strength of containerboard used to make boxes and (2) weight of facings for boxes used to carry different products. For example, a box that has a 65-lb gross weight must have 84 lb/1,000 ft^2 of facings; two 42-lb facings would normally be used. Failure of the shipper to comply with these classifications could lead to penalties such as higher transportation charges, refusal of the shipment by the carrier, or rejection of payment for a freight claim.

Corrugated box shipments closely track U.S. industrial activity. Nondurable goods account for about 70% of total shipments, and food and beverage is the largest end use. Corrugated box shipments in 1988 reached a record 308.5 billion ft^2—up 3.6% from the previous year. This followed a 4.9% increase in 1987 and a 6.1% increase in 1986. After the recession-year low of 235.2 billion ft^2 was reached in 1982, the industry began rebounding with a 7.3% jump in 1984, followed by another hike of 6.0% in 1985.

Corrugated box shipments during the past decade grew at about a 3% average annual rate. The fastest growth was in the Southeast, Southwest, and West, and the slowest growth was in the Northeast and Midwest, reflecting the movement of industry to the so-called Sun Belt region. The Southeast's share of total U.S. box shipments increased from about 10.1% in 1960 to 18.6% in 1988, while the Northeast's share dropped from 27.3% to 18.0%. The East Central region also showed a major decline, with its share dropping from 21.4% in 1960 to 14.4% in 1988.

Corrugated prices over the past decade did not keep up with prices for other industrial products, which put pressure on industry profit margins. For example, the Fibre Box Assn.'s corrugated price index rose 50.9% between 1976 and 1987, while the Producer Price Index increased 68.1%. This was a substantial improvement from 1972-83, when FBA's index moved up just 43.2%, compared with PPI's jump of 89.3%. Overall, the average price of corrugated

U.S. PRICE INDEXES FOR MAJOR CLASSES OF CONVERTED PRODUCTS

(1982 = 100)

Year	Converted paper and paperboard products	Sanitary paper products and stock	Paper bags and shipping sacks	Paper boxes and containers	Composite cans
1988	125.8	117.2	149.0	125.6	126.7
1987	114.7	109.1	125.9	115.4	117.0
1986	109.4	108.1	116.9	107.8	115.1
1985	108.9	106.6	111.9	108.8	114.7
1984	106.4	103.4	110.5	105.7	110.7
1983	100.4	102.1	99.0	99.5	106.5
1982	100.0	100.0	100.0	100.0	100.0
1981	97.9	98.2	n.a.	97.7	91.4
1980	90.2	91.9	93.6	89.4	84.9
1979	79.4	79.1	83.7	79.1	75.9
1978	70.5	71.7	72.5	69.9	70.3
1977	66.8	66.9	65.2	67.1	65.1
1976	64.3	60.6	62.1	66.0	60.0
1975	61.2	55.0	59.2	63.3	56.1
1974	54.8	44.0	52.6	58.5	48.1
1973	46.0	35.3	45.4	49.9	41.0
1972	43.0	34.2	40.9	46.4	38.8
1971	41.5	33.8	38.0	44.7	37.6
1970	40.8	32.5	40.6	43.3	36.3

n.a. = Not available.

Source: Bureau of Labor Statistics.

containers has increased at only 75% of the PPI.

Corrugated containers are produced at two types of manufacturing plant: corrugated container plants (converting plants) and sheet plants. Both types of plant make corrugated container blanks, but only the corrugated container plant has a corrugator. Sheet plants purchase rolls or sheets of corrugated paperboard from corrugated container plants, and they cut and print these into container blanks.

RANKING OF U.S. CORRUGATED CONTAINER PRODUCERS BY CAPACITY

	Company	Number of U.S. plants	1988 capacity (billion ft²)
1	Stone Container	86	43.0
2	Weyerhaeuser	43	28.3
3	Smurfit/CCA	49	28.0
4	International Paper	35	23.0
5	Temple-Inland	31	20.2
6	Georgia-Pacific	30	19.6
7	Great Northern Nekoosa	23	18.0
8	Willamette	19	14.0
9	Union Camp	24	12.0
10	Gaylord Container	21	11.5
11	Boise Cascade	22	10.0
12	Packaging Corp. of America	27	9.1

Source: *Pulp & Paper* estimates.

In 1988, there were 1,562 manufacturing plants in the U.S., of which 640 were corrugated converters and 922 were sheet plants. The number of sheet plants grew relative to the total because of the lower capital costs and technology required to build them. Also, some corrugator plants were converted exclusively to sheet plants. Nevertheless, sheet plants in 1988 accounted for only about 13.7% of total corrugated box shipments, compared with 11.7% in 1970.

The corrugated container industry is highly integrated with paperboard manufacturing. Integrated producers are companies that operate either a linerboard or corrugating medium mill and a corrugator plant. These companies account for about 75% of total U.S. corrugated box shipments. Nonintegrated producers generally operate sheet plants, and they are dependent on integrated producers for their raw materials. Consequently, independent producers are often at a competitive disadvantage, particularly when containerboard is in tight supply.

Unlike paperboard mills that operate continuously, corrugated container plants operate one to two shifts a day, generally on a five- to six-day week. Production units vary in size, with an average of 94 employees per converting plant and 10 employees per sheet plant. They are located close to their markets, principally large industrial and urban centers.

As mentioned earlier, lagging container prices have put the industry under significant cost pressure. This has forced most container plants to improve productivity, and the results have been dramatic. Shipments per week per employee rose from 46,600 ft² in 1970 to 84,000 ft² by 1987—an increase of 80%. The total number of employees in the industry declined during this period from 74,100 in 1970 to a low of 59,100 in 1982. However, it began rebounding in 1983 and reached 69,500 in 1987. The sharp improvement in productivity helped slow the industry's rise in unit labor costs. While total hourly payroll costs spiraled upward by 209% during this period, unit labor costs increased 68%, according to FBA data.

U.S. CORRUGATED PRODUCTION AND INVENTORY

	Production[1] (billion ft²)			Inventory[3]	
Year	Single wall	Double and triple wall	Total[2]	Tonnage (000 short tons)	Weeks of supply
1988	299.3	28.8	329.5	2,486	5.7
1987	289.4	27.6	317.0	2,237	5.8
1986	274.6	26.0	300.5	2,549	7.1
1985	258.9	24.5	283.4	2,882	8.4
1984	256.2	24.7	282.0	2,437	7.2
1983	240.3	22.7	264.2	2,584	8.9
1982	224.2	20.9	246.3	2,729	9.4
1981	229.8	22.1	253.0	1,984	6.2
1980	229.1	21.7	251.9	1,979	6.2
1979	236.7	23.2	261.1	1,961	5.8
1978	232.8	22.3	256.4	2,436	7.2
1977	217.2	20.4	238.8	2,527	8.1
1976	207.9	18.6	227.8	2,185	7.2
1975	186.2	15.9	203.2	2,323	8.2
1974	203.4	19.1	224.1	1,595	4.7
1973	216.8	20.2	238.5	1,603	5.1
1972	200.9	17.6	220.1	1,639	5.7
1971	183.8	15.1	200.3	1,879	7.0
1970	177.1	14.1	192.7	1,760	6.5

1. Production includes waste and trim before fabrication.
2. Total includes single-face production which has averaged around 1.3 to 1.5 billion ft2/year.
3. Inventory of linerboard, corrugating medium, and filler board at box plants and paperboard mills based on inventory at January 1 of each year.

Source: Fibre Box Assn.

Productivity climbed because manufacturers switched to faster and more efficient corrugators. Other printing and converting equipment improved as well. Flexographic printing and the rotary die cutter were adopted in the 1960s, and the continuous corrugator emerged in the mid-1970s. Today, new state-of-the-art continuous corrugators run at 800 to 1,000 fpm, compared with about 600 fpm for a typical corrugator in the early 1970s.

Such high-speed machines place increasing importance on moisture uniformity, mechanical roll quality, and bonding speed of liners to medium. Moisture variation in containerboard may cause warp that high-speed corrugators cannot tolerate, while roll defects may lead to costly downtime from web breaks. More U.S. containerboard manufacturers are interested in meeting uniform moisture requirements.

Changing market requirements. The trend toward stacking containers to greater heights on pallets in warehouses has increased the demand for containers with greater top-to-bottom compression strength. This trend is being hastened by a shift from rigid metal and glass containers to plastic packaging in primary containers. At the same time, palletization has eliminated much of the manual handling of individual corrugated cases in the transportation system.

As a result, ring crush, which measures compression strength, is replacing bursting strength (mullen) as the most relevant performance requirement for corrugated board. (See Linerboard section.) Several major containerboard producers have begun marketing high-ring-crush board that offers higher yield (more surface area per ton).

Both the new emphasis on compression strength and the need to reduce fiber costs were behind an industry proposal several years ago for an alternate to Rule 41. However, few permits were taken out to test the proposed alternate rule, which measures box construction on the basis of the edge-crush or short-column test. Although the new rule seemed feasible in the limited trials that were conducted, there was little economic incentive to change, according to William O. Kroeschell, vice president of product technology, Stone Container Corp. Nevertheless, an increasing number of mills, converting plants, and end users are measuring and specifying their board and finished boxes in terms of compression strength.

One method of achieving high compression strength is through chemical saturation of containerboard. This has become feasible through development of new types of saturators using chemicals such as sodium silicate and urea formaldehyde, which can also improve fire and humidity resistance in boxes. International Paper Co. (Anvil Box) and several other companies have begun to offer such chemically enhanced products. Nekoosa Packaging Corp. (Duo Corr), among others, makes a double-laminated corrugating medium with substantially higher crush resistance, bursting strength, and ring crush. Single-wall boxes with the double-laminated medium can be substituted for bulkier, expensive double-wall boxes. Laminating is done at the corrugator using polyvinyl acetate adhesive.

Another trend is toward better graphic quality of corrugated containers. The corrugated box is increasingly serving not only as a shipping container, but also as a point-of-purchase display in self-service mass-merchandise stores. During the 1980s, 17 flexographic presses were installed by 14 companies in North America to preprint linerboard. Such preprinted linerboard offers higher-quality graphics than conventional postprinting of corrugated board. It is also less expensive than the higher-quality process of litho-laminating labels.

L.C. Schiffenhaus Jr., vice president of Schiffenhaus Inc., estimated in 1987 that preprint represented about 5 billion ft^2—or nearly 2%—of the total U.S. corrugated market. However, he estimated that total U.S. preprint capacity was about 13.5 billion ft^2, with another 2.5 billion ft^2 located in Canada. Preprint volume has grown since 1987 because major packagers of consumer goods have increasingly shifted to higher-quality preprint packaging, spurring other companies to do the same.

The growth of preprint has also been helped by the development of more cost-effective board substrates in North America, such as the white-top linerboard introduced by Chesapeake Corp. The main substrates currently being used for preprinting include coated kraft board, solid bleached linerboard, and mottled/unbleached linerboard. (See Linerboard section.)

Most major U.S. integrated producers now have preprint

U.S. CORRUGATED BOX SHIPMENTS BY REGION

(billion ft^2/year)

Year	Total	North-east	South-east	East Central	North Central	South Central	West
1988	308.5	55.6	57.5	44.5	37.9	61.1	51.9
1987	297.8	54.3	54.8	43.7	35.7	58.5	50.7
1986	283.9	52.3	51.6	41.9	34.5	55.3	48.3
1985	267.5	50.1	48.0	40.3	32.7	52.1	44.3
1984	267.6	51.1	47.5	40.3	32.8	51.4	44.5
1983	252.5	50.3	44.1	37.2	31.3	47.4	42.2
1982	235.2	48.0	39.7	34.3	28.8	44.4	40.0
1981	246.2	50.1	41.7	37.6	30.0	45.2	41.6
1980	241.4	50.6	41.3	36.9	30.1	42.9	39.6
1979	250.6	53.3	41.6	41.1	31.8	43.2	39.7
1978	243.9	52.3	38.8	41.4	31.4	41.8	38.3
1977	227.2	48.3	35.2	39.8	29.6	38.6	35.6
1976	216.4	46.8	32.8	38.3	28.5	36.2	33.8

Source: Fibre Box Assn.

operations, including Jefferson Smurfit/CCA, International Paper, MacMillan Bloedel, Menasha Corp., Nekoosa Packaging, Stone Container, Union Camp Corp., Willamette Inc., Westvaco Corp., and Weyerhaeuser Co. Some integrated producers became involved with preprint operations through acquisitions. For example, Chesapeake purchased the Displayco Group preprint operations from Schiffenhaus Industries in 1989, and it bought Distinctive Printing & Packaging Co. in 1987. Smurfit in 1989 acquired Tri-Pak Corp., a leading point-of-purchase display manufacturer.

Independent converters with preprint operations include Lux Packaging Co., Pioneer Container Corp., and Southern Container Corp. Most litho-laminated containers are produced by independent converters such as Rand Whitney Container Corp.

Future outlook. A 2.5% average annual growth rate is forecast for corrugated containers during 1987-91—about the same rate expected for containerboard capacity, according to the Dept. of Commerce. However, demand for boxes from industrial and manufacturing operations weakened in early 1989, which could reduce growth to an average 1.5% for each of the following two years. In addition, plastics will continue to advance in traditional corrugated markets. However, containerboard producers will hold their own by diversifying into new and existing market areas.

Principal market growth is expected in shipping containers and displays for paper and allied products, chemical and allied products, plastics, and electrical machinery and equipment. Industry growth will feature continued development and use of preprinted linerboard; increased use of flexography in color printing; improvements in graphic design; more computerization and automation in all phases of box plant operations; better marketing and distribution methods; modifications of existing box specifications for compression and burst strength; greater emphasis on high-strength boxes for stacking; increased use of laminated board; improved coatings, adhesives, and inks; and greater use of E-flute board in point-of-purchase displays of shipping containers.

Despite high transportation costs, significant real growth is expected in U.S. exports of corrugated products, especially to Canada, Mexico, and the Caribbean Basin. Several box plants are being established on both sides of the border to serve Mexico's growing Maquiladora industry. In 1988, corrugated container exports amounted to 181,366 short tons, which is equivalent to about 2 billion ft^2.

Folding paperboard boxes. Folding cartons are used as secondary packaging to protect the primary product through shipping and distribution. They are also used to display the product to consumers. Folding cartons are typically die-cut, printed, and shipped flat from folding carton plants to manufacturers who assemble and fill the cartons on high-speed production lines.

SUMMARY OF STATISTICS FOR CORRUGATED AND SOLID-FIBER BOX INDUSTRY

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1987	1,588	105,900	$16,073	$468.2
1986	—	102,000	13,335	433.5
1985	—	100,000	12,579	420.3
1984	—	98,900	12,719	426.2
1983	—	96,900	11,045	248.1
1982	1,492	93,800	10,303	279.5
1981	—	97,300	10,760	271.2
1980	—	97,200	9,651	420.5
1979	—	103,700	8,976	303.0
1978	—	105,800	8,030	282.5
1977	1,472	101,500	7,351	243.3
1976	—	101,400	6,682	185.1
1975	—	94,700	5,821	207.9
1974	—	106,800	6,015	200.9
1973	—	109,700	5,230	125.0
1972	1,265	107,900	4,309	101.5
1971	—	102,700	3,668	87.5
1970	—	104,700	3,545	108.9
1969	—	105,600	3,500	161.9
1968	—	100,700	3,231	135.6
1967	568	97,100	2,960	127.7

Paperboard consumed (estimated):
1982: 18,306,800 short tons
1977: 17,272,100 short tons

Source: Bureau of the Census.

Paperboard grades that are used for folding cartons must meet technical specifications for scoring, bending, and folding without cracking or breaking; for stiffness and resistance to bulge and surface slack; and for surface smoothness for printing, embossing, or laminating. Paperboard for folding cartons is made in single- and multi-ply grades. Single-ply grades produced from virgin woodpulp are used to make solid bleached sulfate (SBS) board and solid unbleached sulfate (SUS), also called natural kraft board. SBS is chosen for food and medicinal packaging because of its whiteness, and SUS is used for heavier items requiring extra strength, such as liquids and hardware goods. Multi-ply grades made from processed wastepaper are used for food and commercial products that require low-cost, minimum-protective packaging. Coatings such as kaolin clay, polyethylene, wax, and other special treatments are usually applied to boxboard to improve strength, moisture resistance, and printing surface smoothness.

Domestic folding carton shipments generally follow consumer spending and real disposable income levels, but carton sales have often lagged slightly behind fluctuations in the nation's economic growth because demand for many basic consumer goods is relatively inelastic. Although the dollar volume of folding carton shipments grew at an average annual rate of 7% between 1977 and 1988, tonnage volume grew less than 1% annually during this period. Part of the problem was substitution of plastic packaging and use of lower-density boxboard in the manufacturing process.

Folding carton volume has suffered most because of competition from alternatives such as flexible packaging, rigid plastic containers, and E-flute corrugated board—all of which made inroads into traditional folding carton markets during the past decade. For example, many brands of laundry detergent and disposable diapers switched to plastic packaging during the past five years. The folding carton industry rebounded somewhat with growth in new and existing end uses, especially those related to food. Food packaging accounts for about one-half of all folding carton shipments.

Shipments of folding cartons totaled approximately 3.1 million short tons in 1988—an increase of 2.8% from 1987, according to the Paperboard Packaging Council (PPC). This growth followed a 1.1% increase in 1987 and a 3.8% increase in 1986. The cumulative rise in shipments is attributed mainly to greater packaging demand from the food and beverage sectors. These sectors accounted for about 57% of the value of folding carton tonnage shipped in 1988.

The comparatively weaker performances of 1987-88 resulted primarily from shortages of all grades of boxboard. Nonetheless, sales of packaged nondurables—the major end-use market for the folding carton industry—showed renewed strength. Several nondurable end-use markets such as dry and frozen foods, beverage carriers, sporting goods, candy, and paper goods have expanded, while markets for textiles, tobacco, medicinal products, and hardware have declined.

In recent years, a trend has developed to improve the quality of boxboard used in folding cartons. This has led to the increased use of clay-coated bleached and unbleached kraft grades. Also, low-grade recycled chipboards have been displaced by clay-coated recycled boards. In 1988, recycled grades held approximately 44.4% of the folding carton market, followed by bleached kraft board with a 38.1% share, and unbleached kraft board with a 17.5% share.

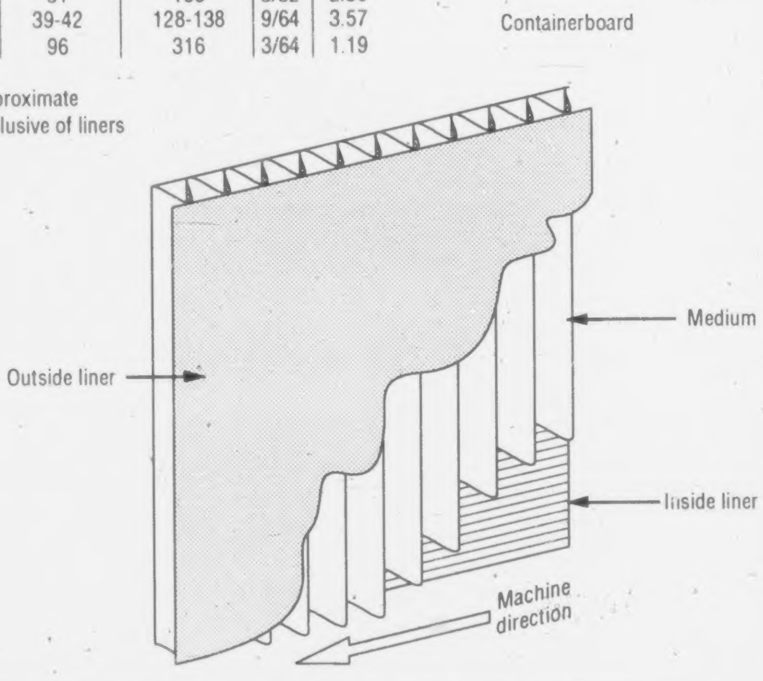
A significant discrepancy exists between PPC and American Paper Institute data concerning paperboard tonnage used in the folding carton industry. PPC figures do not include milk carton and food service stock, which accounts for about 1.4 million tons. Furthermore, folding carton plants waste about 18% of the boxboard they purchase from mills, while mills report as production some of the roll trim that is not shipped. The remainder of the discrepancy is related to product definitions.

The folding carton industry is expected to show scant growth in 1989, due largely to continued boxboard shortages. During 1990-91, shipments should increase by only 1.0% annually, due to a general slowdown in the nation's

COMMON FLUTES USED IN CORRUGATED CONTAINERBOARD PRODUCTION

Flute	Number of flutes[1] per Lineal foot	Number of flutes[1] per Lineal meter	Flute height[2] inch	Flute height[2] mm
A	36	118	3/16	4.76
B	51	168	3/32	2.38
C	39-42	128-138	9/64	3.57
E	96	316	3/64	1.19

[1] Approximate
[2] Exclusive of liners



Source: Metrication for the Pulp & Paper Industry, Miller Freeman Publications.

economic growth and to continued boxboard shortages. Manufacturers will continue emphasizing better package design and graphics as well as tamper-resistant technology.

Productivity improvements should result from better cutting and creasing equipment, higher-speed box manufacturing machinery and printing presses, better coating and gluing equipment, and infrared ink-curing systems. Further automation and computerization of manufacturing, marketing, and distribution should also boost productivity.

SETUP PAPERBOARD BOXES

These specialty boxes are custom made for specific products that require good protection and high-quality appearance. The containers are produced in rigid form, in contrast to folding or collapsible boxes. They are produced from solid or combination board—also called nonbending chipboard—depending on the style of the container. Setup boards range in thickness from 0.016 to 0.065 in., and weigh 60 to 260 lb/1,000 ft^2.

Stiffness, rigidity, and strength are essential qualities. Rigid boxboard can be laminated or pasted together to form nonbending boards of greater thickness. It can be made from plain chipboard, filled newsboard, single new vat-lined chipboard, or single white vat-lined chipboard. Setup paperboard is usually made from a cheaper grade of wastepaper than folding cartons because it is not subject to scoring and bending. The finished surface is typically overwrapped with a specialty packaging paper.

After a decline in shipments of more than 5% annually between 1962 and 1982, the industry grew a modest 1.5%/year between 1983 and 1988. In 1988, an estimated 275,000 to 300,000 tons of mostly recycled boxboard was used in the manufacture of rigid setup boxes. Approximately 500 facilities manufactured setup boxes in the early 1960s; the number dwindled to about 175 firms by 1986. Accordingly, employment fell by almost half from approximately 20,500 in 1962 to 10,600 in 1982. The low point was reached in 1984, when just 9,300 people were working. The industry rebounded to about 9,700 in 1986.

Since the early 1980s, the industry has largely halted its downward spiral. Subsequent fluctuations in growth are attributable to U.S. economic trends and to changing disposable income and consumer spending levels.

The traditional rigid box is more expensive to produce than a folding carton, so rigid boxes are primarily used to package products sold at high profit margins, such as stationery, jewelry, toiletries, and chocolates.

In recent years, the industry has improved its competitive position by restructuring through mergers and acquisitions. It has also improved its cost effectiveness and productivity, diversified its product mix, and entered new markets. Some producers have added folding carton plants and paperboard/plastic combinations and laminations to their product lines. In addition, new technology has enabled the industry to expand into packaging for computer software, video equipment, food and beverages, advertising specialties, cosmetics and soaps, confectionery, and products previously dominated by other packaging mediums.

The real value of setup boxes is expected to rise by an annual compound rate of 1.5% during 1987-91, provided that the industry continues to adapt its packaging products to new, high-value nondurable goods. In some of their traditional markets, setup boxes will be challenged by folding cartons and plastics, but they are expected to retain share in high-value specialty packaging. Growth markets are expected to include packaging for cosmetics, pharmaceuticals, confectionery, and electronics.

U.S. CORRUGATED BOX PRICE TRENDS

Year	Corrugated shipping containers for food/beverage[1]	National overall corrugated box price trend[2]	
	(Mar. 1980 = 100)	(1982 = 100)	($/1,000 ft^2)
1988	143.9	123.3	$46.73
1987	128.4	113.3	42.94
1986	116.6	101.6	38.48
1985	119.3	106.1	40.22
1984	115.5	107.3	40.75
1983	106.8	97.2	36.85
1982	108.7	100.0	37.92
1981	108.1	101.8	38.61
1980	100.9	94.2	35.73
1979	n.a.	83.6	31.71
1978	n.a.	74.4	28.23
1977	n.a.	74.5	28.24
1976	n.a.	75.1	28.48
1975	n.a.	73.3	25.79
1974	n.a.	67.8	25.91
1973	n.a.	54.2	20.56
1972	n.a.	47.5	18.03
1971	n.a.	46.1	17.49

n.a. = Not available.
Sources: 1. Bureau of Labor Statistics. 2. Fibre Box Assn.

LARGEST CANADIAN CORRUGATED BOX PRODUCERS IN CAPACITY

Company	Number of Canadian plants	Annual capacity (million ft^2)
MacMillan-Bathurst[1]	13	8,280
Domtar	13	6,480
Canadian Pacific Forest Products	7	3,420
Atlantic Packaging	4	2,580
Kruger	3	1,920
Crown Forest	2	1,416

[1] Joint venture between MacMillan Bloedel and Stone-Consolidated.

Source: *Canadian Paper Analyst.*

FIBER CANS, DRUMS, AND TUBES

Composite cans, tubes, and cores are produced by the spiral or convoluted winding of paperboard strips around a core or mandel. The paperboard can be recycled board, kraft paperboard, or semichemical board. Strength is produced by the use of two or more plies. If special barriers are required, the board is first laminated with plastics or foil, or coated with hotmelts and other specialty coatings. An adhesive such as dextrine is applied to the strips during winding. The endless formed tube is cut on a mandel to desired sizes. For composite cans, either metal or plastic caps are used to seal the ends.

The market matured in the 1980s, mainly because composite cans have not been able to penetrate new, high-volume, consumer packaging areas. Furthermore, composite cans have lost most of their market share for motor oil and frozen juice concentrate packaging. On the positive side, however, industrial demand for fiber drums, tubes, and cores has remained strong. In 1988, an estimated 1.25 million tons of recycled paperboard and 155,000 tons of unbleached kraft paperboard were used in the manufacture of tubes, cores, cans, and drums.

Sonoco Products Co., Jefferson Smurfit Corp., Caraustar Industries, and Greif Brothers Corp. dominate the industrial sector of this business. All but Greif Bros. are integrated producers. Sonoco, Greif, and Smurfit's affiliate Container Corp. of America also produce plastic industrial drums,

CORRUGATED AND SOLID FIBER BOX SPECIFICATIONS FOR RAILROAD (RULE 41)

		Corrugated fiberboard			
		Single wall		Double wall	
Maximum weight of box and contents (lb)	Maximum inside dimensions[1] (in.)	Minimum combined weight of facings (lb/1,000 ft^2)	Minimum bursting test of combined board (psi)	Minimum combined weight of facings[2] (lb/1,000 ft^2)	Minimum bursting test of combined board (psi)
20	40	52	125	—	—
30	50	66	150	—	—
40	60	75	175	—	—
65	75	75	200	92	200
90	90	138	275	110	275
120	100	180	350	126	350
140	110	—	—	222	500
160	120	—	—	270	600
275	120	—	—	—	—

		Corrugated fiberboard			
		Triple wall		Solid fiberboard	
Maximum weight of box and contents (lb)	Maximum inside dimensions[1] (in.)	Minimum combined weight of facings[2] (lb/1,000 ft^2)	Minimum puncture test of combined board (in.-oz./in.-tear)	Minimum combined weight of component plies[3] (lb/1,000 ft^2)	Minimum bursting test of combined board (psi)
20	40	—	—	114	125
30	50	—	—	—	—
40	60	—	—	149	175
65	75	—	—	190	200
90	90	—	—	237	275
120	100	—	—	283	350
140	110	—	—	330	500
160	120	—	—	360	600
275	120	264	1,100	—	—

1. Length, width, and depth added.
2. Including center facing.
3. Exclusive of adhesives.

DISTRIBUTION OF PAPER/PAPERBOARD PRODUCTS TO MAJOR CUSTOMERS

Paperboard containers and boxes	**% of total dollar output**	**Paper and allied products***	**% of total dollar output**
Food	31.2%	Printing and publishing	23.1%
Wholesale and retail	5.4	Paper and allied products	17.9
Drugs, cleaning, etc.	5.0	Paperboard containers and boxes	12.4
Paper and allied products	4.8	Wholesale and retail	5.1
Eating and drinking places	4.6	Food	5.0
Rubber and miscellaneous plastic products	4.1	Health, education, and social services	2.5
Paperboard containers and boxes	3.6	New construction	1.5
Glass and glass products	2.6	Chemical and chemical products	1.3
Miscellaneous manufacturing	2.3	Rubber and miscellaneous plastic products	1.1
Other fabricated metal products	2.1	Business services	1.1
Other intermediate	30.3	Other intermediate	11.8
Total intermediate	96.0	Total intermediate	82.8
Purchases by individuals	1.4	Purchases by individuals	15.5
Government purchases	1.1	Government purchases	3.4
Exports	1.4	Exports	5.8
Imports	-0.5	Imports	-9.4
Other final demand	0.6	Other final demand	1.9
Total final demand	4.0	Total final demand	17.2
Total intermediate and final demand	100.0	Total intermediate and final demand	100.0

* = Excludes paperboard containers and boxes.

Source: Dept. of Commerce, 1983 Input/Output Tables.

FOLDING PAPERBOARD BOX SHIPMENTS BY END USE

(million $)

	1988	1982	1977
Wet food and frozen (including ice cream)	$568.80	$409.50	$311.20
Dry food and produce (including pet food)	677.90	544.20	376.40
Bottled and canned beverages (including carriers)	443.80	375.00	232.00
Soaps and detergents	209.90	205.50	143.80
Tobacco	148.20	131.70	93.70
Hardware, household supplies	204.40	183.10	166.60
Candy, biscuits, crackers	314.80	230.70	155.10
Perishable bakery	236.90	186.70	140.30
Cosmetics and medicine	380.70	380.10	236.00
Paper goods (including book mailers)	293.30	191.90	127.20
Retail food carryout (boxes and trays)	225.80	114.80	77.00
All other uses	141.90	108.60	99.60
Miscellaneous	93.60	67.20	68.10
Total	3,940.00	3,129.00	2,227.00

Source: Paperboard Packaging Council.

which allows these producers to offer a range of products.

Shipments of tubes and cores have shown modest growth in recent years. The largest markets for tubes are consumer and industrial packaging and shipping. The largest single market for cores is the paper industry, where they are widely used for towel and tissue products as well as office supplies.

Markets for solid fiber drums cut across industrial, chemical, and construction sectors. Fiber drums have shown surprising growth in recent years due to growth in the hazardous waste industry.

SHIPPING SACK END-USE MARKETS

(million sacks)

End use	1988[1]	1987	1984	1980
Seeds	—	149	189	179
Sugar	—	63	63	71
Dog and cat food	—	244	211	194
Flour and flour mix	—	154	140	136
Livestock and poultry feed	—	407	446	499
Other agriculture and food	—	353	335	336
Subtotal	1,454	1,370	1,384	1,415
Cement and mortar mix	—	222	169	112
Portland cement	—	96	101	109
Masonry cement	—	70	84	82
Insulation	—	23	52	89
Other building materials	—	152	149	141
Subtotal	569	563	555	533
Fertilizer	—	143	170	221
Plastic materials	—	123	132	144
Salt and water softeners	—	116	126	128
Other chemicals	—	294	333	332
Subtotal	728	676	761	825
Clays	—	118	151	163
Limestone	—	104	124	123
Other minerals	—	148	181	191
Subtotal	400	370	456	477
Miscellaneous	359	305	233	217
Total	3,509	3,284	3,389	3,467

[1] End-use details for 1988 not available.

Source: Paper Shipping Sack Manufacturers' Assn.

U.S. PRODUCTION OF UNBLEACHED KRAFT AND RECYCLED PAPERBOARD FOR TUBE, CAN, AND DRUM STOCKS

(000 short tons)[1]

Year	Kraft	Recycled
1988	68	1,145
1987	65	1,124
1986	54	1,043
1985	64	1,021
1984	74	1,038
1983	99	858
1982	151	767
1981	334	808
1980	220	564
1979	232	628
1978	202	602
1977	180	680
1976	172	702
1975	145	631
1974	213	733
1973	215	763
1972	216	728
1971	159	642
1970	194	573
1969	180	527

[1] Some bleached kraft paperboard is also produced for these uses, but is not included in these data.

Source: Bureau of the Census.

END USES FOR RIGID PAPER BOXES

(% distribution)

End use	1980	1970
Textile, apparel, hosiery	4.4%	18.9%
Department stores and specialty shops	6.8	13.1
Cosmetics and soaps	5.5	6.2
Confections	12.6	7.9
Stationery and office supplies	13.5	8.2
Jewelry and silverware	9.3	3.2
Photographic	4.5	2.6
Shoe and leather	0.3	4.4
Drugs, chemical, pharmaceuticals	7.5	4.2
Toys and games	1.4	7.0
Hardware and household supplies	5.5	4.9
Food, beverages	4.3	0.8
Sporting goods	1.2	2.6
Electronics	3.6	—[1]
Educational	3.7	—[1]
Other and miscellaneous customers	15.9	9.6

[1] Listed under other and miscellaneous customers.

Source: National Paperbox & Packaging Assn.

FIBER CANS, DRUMS, AND SIMILAR PRODUCTS: SHIPMENTS AND TONNAGE BY TYPE (SIC CODE 2655)

	1987	1982	1977	1972
Fiber drums				
Product shipments (million $)	311.5	289.8	223.8	136.9
Product shipments (000 tons)	n.a.	137.4	149.4	160.1
Fiber and composite cans				
Product shipments (million $)	448.2	701.4	469.0	253.2
Product shipments (000 tons)	n.a.	212.5	210.9	216.1
Cores and tubes				
Product shipments (million $)	532.7	341.7	263.4	164.3
Product shipments (000 tons)	817.8	748.3	638.7	624.5
Paperboard cores, reels[1]				
Product shipments (million $)	48.7	48.8	36.7	31.0
Product shipments (000 tons)	29.0	41.0	63.5	79.1
Vulcanized fiber products[2]				
Product shipments (million $)	40.5	25.4	6.6	14.0
Product shipments (000 tons)	n.a.	n.a.	n.a.	34.3
Other, not specified				
Product shipments (million $)	n.a.	35.0	40.8	20.0

n.a. = Not available.

[1] Includes spools, bobbins, and blocks.

[2] Includes boxes, cans, tubes, drums.

Source: Bureau of the Census.

BAGS (EXCEPT TEXTILE): SHIPMENT AND TONNAGE BY TYPE

	1987	1982	1977
Grocers bags and sacks			
Product shipments (million $)	916.4	917.1	612.6
Product shipments (000 tons)	1,657.9	1,913.1	1,699.0
Variety (merchandise) bags			
Product shipments (million $)	106.7	152.6	139.7
Product shipments (000 tons)	123.1	212.8	255.1
Shopping bags (uncoated)			
Product shipments (million $)	60.8	37.4	33.2
Product shipments (000 tons)	35.0	30.0	42.0
Other paper bags			
Product shipments (million $)	24.7	56.8	12.3
Product shipments (000 tons)	n.a.	56.1	21.9
Specialty bags and liners (coated)			
Product shipments (million $)	400.4	205.5	210.6
Product shipments (000 tons)	n.a.	153.1	n.a.
Shipping sacks (single and multiwall)			
Product shipments (million $)	1,187.3	846.5	658.8
Product shipments (000 tons)	n.a.	n.a.	997.6

Note: Polyethylene grocery and variety bag tonnage was estimated at 133,000 tons valued at $267.8 million in 1982. Plastic shipping sack: 22,000 tons valued at $38.6 million.
n.a. = Not available.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2677: ENVELOPES

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	298	27,900	$2,621	$61.8
1986	—	25,200	2,337	72.8
1985	—	24,000	2,147	74.1
1984	—	25,100	2,169	63.5
1983	—	24,800	1,888	32.6
1982	296	24,400	1,771	45.1
1981	—	25,600	1,601	38.1
1980	—	25,600	1,460	55.2
1979	—	24,900	1,304	38.7
1978	—	22,900	1,121	29.3
1977	265	22,600	991	22.9
1976	—	21,700	870	22.7
1975	—	21,900	830	19.1
1974	—	24,300	868	19.2
1973	—	23,300	690	21.1
1972	247	22,900	621	17.4
1971	—	22,400	573	23.1
1970	—	23,400	574	21.6

Paper consumed (estimated)[1]:
1987: n.a.
1982: 822,800 short tons
1977: 677,000 short tons
1972: 695,000 short tons
Number envelopes produced:
1987: n.a.
1982: n.a.
1977: 97,889 million
1972: 96,599 million

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.

[1] An estimated 13,000 tons of paperboard included for 1977 and 29,000 for 1972.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2675: DIE-CUT PAPER AND BOARD

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	393	15,500	$1,739	$29.4
1986	—	17,900	1,795	31.0
1985	—	16,900	1,730	35.0
1984	—	17,500	1,931	46.7
1983	—	16,300	1,898	30.4
1982	398	15,900	1,680	32.7
1981	—	17,200	1,677	23.2
1980	—	16,600	1,454	41.0
1979	—	17,000	1,468	32.7
1978	—	15,100	1,189	26.4
1977	371	14,300	1,058	15.3
1976	—	15,300	1,027	28.6
1975	—	14,800	943	17.1
1974	—	16,500	923	23.3
1973	—	15,900	747	12.9
1972	374	15,200	676	10.6
1971	—	17,300	612	17.8
1970	—	18,200	612	17.8

Paper consumed (estimated):
1987: n.a.
1982: 355,400 short tons
1977: 259,000 short tons
1972: 510,000 short tons
Paperboard consumed (estimated):
1987: 641,100 short tons
1982: 983,600 short tons
1977: 927,000 short tons
1972: 953,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2676: SANITARY PAPER PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	129	38,100	$11,593	$429
1986e	—	37,800	11,153	466
1985	—	38,000	10,751	487
1984	—	38,100	10,327	313.0
1983	—	36,700	9,240	373.0
1982	138	36,700	9,086	271.1
1981	—	36,600	8,346	248.2
1980	—	37,700	7,636	250.9
1979	—	37,700	6,615	265.4
1978	—	35,000	5,591	210.6
1977	120	34,500	4,921	199.1
1976	—	32,900	4,410	108.4
1975	—	31,400	3,884	121.2
1974	—	31,300	3,265	65.2
1973	—	28,200	2,325	109.0
1972	108	26,300	2,072	119.6
1971	—	24,000	1,716	52.9
1970	—	24,600	1,654	50.5

Paper consumed (estimated):
1987: 3,488,600 short tons
1982: 3,598,100 short tons
1977: 3,651,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
e = Estimate.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2678: STATIONERY PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	189	11,500	$1,229	$25.4
1986	—	12,700	1,201	43.5
1985	—	12,400	1,102	48.9
1984	—	13,600	1,173	42.2
1983	—	13,100	1,132	20.8
1982	214	12,600	1,034	21.4
1981	—	11,900	892	13.1
1980	—	13,000	836	12.7
1979	—	13,400	766	14.6
1978	—	13,900	747	18.4
1977	242	12,600	652	15.9
1976	—	12,300	653	12.7
1975	—	12,100	591	15.5
1974	—	13,300	605	8.0
1973	—	15,000	493	6.5
1972	431	14,700	450	9.3

Paper consumed (estimated):
1987: 536,800 short tons
1982: 447,300 short tons
1977: 470,000 short tons
1972: 511,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2679*: MISCELLANEOUS CONVERTED PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	785	30,700	$3,672	$75.6
1986	—	28,400	3,223	73.0
1985	—	29,300	3,136	70.4
1984	—	31,600	3,196	70.1
1983	—	31,700	2,817	36.2
1982	809	30,400	2,638	74.3
1981	—	33,300	2,836	57.9
1980	—	35,200	2,554	76.5
1979	—	34,700	2,263	92.9
1978	—	35,100	2,126	92.8
1977	871	34,300	1,938	62.0
1976	—	28,100	1,507	35.2
1975	—	27,000	1,301	37.0
1974	—	29,600	1,284	49.8
1973	—	27,600	1,001	33.4
1972	356	24,200	793	25.5

Paper consumed (estimated):
1987: n.a.
1982: 574,300 short tons
1977: 424,000 short tons
1972: 495,000 short tons
Paperboard consumed (estimated):
1987: 224,000 short tons
1982: n.a.
1977: 169,000 short tons
1972: 112,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
* = Industry definition changed for 1987.
n.a. = Not available.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2657*: FOLDING PAPERBOARD BOXES

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	601	50,500	$5,687	$180.3
1986e	—	36,200	4,560	—
1985	—	36,000	4,447	—
1984	—	35,600	4,421	131.0
1983	—	42,600	3,967	94.3
1982	564	43,700	3,902	105.0
1981	—	44,300	3,557	101.0
1980	—	45,500	3,277	92.2
1979	—	45,000	2,950	76.8
1978	—	45,600	2,884	100.0
1977	574	44,700	2,579	89.8
1976	—	40,600	2,233	65.2
1975	—	38,300	1,952	67.0
1974	—	43,200	1,890	60.0
1973	—	45,300	1,644	41.8
1972	544	45,300	1,487	37.4
1971	—	44,900	1,366	33.7
1970	—	48,700	1,387	49.9

Paperboard consumed:
1987: 3,977,800 short tons
1982: n.a.

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
* = Industry definition changed for 1987.
n.a. = Not available.
e = Estimate.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2655: FIBER CANS, DRUMS, AND SIMILAR PRODUCTS

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1987	280	12,400	$1,517	$70.9
1986	—	12,600	1,517	63.1
1985	—	13,500	1,697	60.5
1984	—	13,900	1,692	41.1
1983	—	14,100	1,627	35.0
1982	307	14,100	1,474	31.1
1981	—	16,200	1,496	37.3
1980	—	15,900	1,370	42.9
1979	—	17,100	1,297	31.2
1978	—	16,300	1,119	23.6
1977	309	16,100	1,011	26.7
1976	—	16,600	936	26.6
1975	—	16,900	837	27.5
1974	—	19,600	828	30.5
1973	—	18,200	673	16.8
1972	282	17,300	568	17.9
1971	—	16,200	495	16.4
1970	—	16,500	465	16.1
1969	—	16,400	445	16.8

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.

Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2652: SETUP PAPERBOARD BOXES

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1987	—	8,600	$433.5	$10.3
1986	—	9,100	552	13.2
1985	—	9,200	479	16.8
1984	—	9,300	466	18.0
1983	—	12,300	569	14.1
1982	261	10,600	433	10.0
1981	—	13,700	511	18.6
1980	—	13,500	465	16.2
1979	—	13,400	434	14.6
1978	—	13,700	409	17.6
1977	312	13,100	361	8.8
1976	—	15,500	402	4.6
1975	—	14,500	350	15.1
1974	—	18,300	387	5.6
1973	—	16,000	320	5.7
1972	395	18,100	321	6.4
1971	—	19,700	332	8.5
1970	—	22,000	326	12.0

Paperboard consumed (estimated):
1987: n.a.
1982: 199,800 short tons
1977: n.a.

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.

Source: Bureau of the Census.

MOLDED PULP PRODUCTS

Pressed and molded pulp goods are made in a unique wet-forming process from virgin or recycled pulp. Products include egg cartons, plates, dishes, prepackaging trays, meat boards and other food trays, fiber pipes, conduit, and fittings. After a steady decline in sales due to the growth of various plastic and polystyrene products between 1973 and 1983, the molded pulp industry appears to be recovering. In 1988, the value of product shipments for the molded pulp industry increased 2.7%—the fifth consecutive year of growth.

The number of molded pulp producers continues to decline in the face of plastic and polystyrene competition. Most of industry capacity is held by four producers. The number of North American molded and processed pulp manufacturing sites, including those in Mexico, has dropped by more than half over the past 15 years to about 22 facilities in 1989.

The largest molded pulp producer, Cascades Inc., continued to grow in 1989. In May, the company acquired all the assets of Diamond Fiber Products Inc. of Palmer, Mass., for an undisclosed amount. The Diamond Fiber Products plant, which now operates under the name Cascades Diamond Inc., makes molded paper products, mainly egg cartons. In the future, the company plans to "substantially increase" the plant's output.

Molded pulp products are made directly from pulp. The furnish is short-fibered, derived usually from clean grades of wastepaper, although groundwood and hardwood sulfate pulp are also used. The secondary fiber or market pulp is first made into a slurry in a conventional pulper, refined, sized, and then formed.

Fibers are drawn from a liquid slurry onto preformed molds by either vacuum suction or cloth covers that catch the fibers. The maximum possible amount of water—usually 25% to 30%—is first removed mechanically, then the molded pulp is either passed through heated tunnels or pressed between heated dies. Molding, pressing, and drying are done in a continuous process.

Molded pulp products are classified into five categories: consumer, food service, retail food packaging, food distribution, and specialty products. These items should not be confused with solid bleached paperboard products, called pressed board, which are machine-stamped or pressed into forms such as dish or tray. (See Bleached Board chapter.)

The consumer sector is the primary market for molded pulp products. Retail food packaging (particularly egg cartons) and food distribution (especially egg trays and fruit packaging trays) are also major markets.

Consumer products such as disposable tableware (cups, plates, and bowls) are sold in retail stores directly to the consumer. Pressed paperboard reportedly dominates this market, and molded pulp products have the second-largest share, but plastic is "making obvious inroads," according to one industry observer.

Beginning in the early 1970s, plastics and polystyrene eroded a significant portion of molded pulp's share of the food-packaging market, especially egg cartons. Although

TYPICAL MOLDED PULP PRODUCTS BY END USE

Consumer products
- Tableware
- Plates
- Dishes

Food service
- Plates
- Trays (bottle, food, etc.)
- Carry-out containers

Food distributors
- Egg cases
- Egg trays
- Fruit packs

Food packaging
- Egg cartons
- Meat trays
- Poultry trays
- Cake circles

Specialty
- Florist vases
- Flower pots
- Seed pots
- Interior packaging
- Minnow buckets

polystyrene cartons maintain a slightly higher market share, in recent years consumer preference has been gradually shifting back toward molded pulp egg cartons because of their high strength, crush resistance due to thick cushioning, and biodegradability.

International trade in molded pulp products is small because of the high bulk-to-value rate of these products. In 1988, exports were valued at $5.5 million—a 5.8% increase from the 1987 level. Major U.S. export markets for pressed and molded pulp goods in 1988 were Canada (34% of total export value), Hong Kong (16%), the U.K. (11%), and Costa Rica (8.5%). In 1988, U.S. imports of all pressed/molded pulp goods decreased 10% in value from $23 million to $20.7 million. Primary suppliers to the U.S. market in 1988 were Canada (62% of total import value), the Philippines (9.5%), and Fed. Rep. Germany (6.5%).

OUTLOOK

The pressed and molded pulp goods industry is expected to continue expanding with a 2.3% increase in product shipments in 1989, according to analyst Gary Stanley in the Dept. of Commerce's *1989 Industrial Outlook*. This growth should occur primarily in the food-packaging sector, despite increased competition from plastic, polystyrene, and other nonpulp-based packaging materials. International trade within this sector will remain relatively small, as exports increase by 5.5% and imports by almost 3%.

During the 1989-93 period, pressed/molded pulp product shipments are forecast to increase an average of 2.2%/year, according to Stanley. Competition from plastics and polystyrene products—especially egg cartons—will increase during the next five years. New packaging media using crystallized polyethylene and polystyrene resins will increase competitive pressure on packages made from traditional materials.

STATISTICS OF U.S. PRESSED AND MOLDED PULP INDUSTRY

Year	Number of establishments	Employees (000)	Value of shipments ($ million)
1987e	23	3.1	$282
1986	—	3.0	271
1985	—	2.9	260
1984	—	3.0	235
1983	—	3.2	227
1982	32	3.2	222
1981	38	3.2	239
1980	—	4.4	225
1979	—	4.6	220
1978	—	5.0	226
1977	38	4.9	240
1976	—	5.3	218
1975	—	5.3	210
1974	—	5.6	205
1973	—	5.6	168
1972	49	6.1	163
1967	58	6.7	146

e = Estimate.

Source: U.S. Industrial Outlook, 1989.

Controversy has risen recently over the environmental impact of processing and burning nonbiodegradable plastics. Polystyrene products, which are manufactured with chlorofluorocarbons, have been shown to cause atmospheric ozone depletion during actual production and final disposal (incineration). This could adversely affect its food-packaging market share (especially with egg cartons) as the full environmental effects are determined. An increase in molded pulp's food-packaging market share is expected as consumers become more aware of the nonbiodegradability of plastic products.

Growth in the molded pulp industry will hinge on establishing new end uses for its products, such as trays for use in microwave and conventional ovens. (Currently, over 70% of U.S. households have at least one microwave oven.) The industry can also stress the benefits its products offer in biodegradability and in economical, durable protection for a wide variety of packaging needs.

NORTH AMERICAN PRESSED AND MOLDED PULP PRODUCERS

Company	Location	Capacity (tpd)
American Fibrit Inc.	Battle Creek, Mich.	30
Cascades Inc.	Kingsey Falls, Que.	25
	Rockingham, N.C.	9
Cascades Diamond Inc.	Palmer (Thorndike), Mass.	75
Cascade Dominion Packaging Ltd.	Brantford, Ont.	40
CKF Inc.	Hantsport, N.S.	n.a.
Fibre Form Corp.	Columbia City, Ind.	n.a.
Fripp's Fibre Form Ltd.	Tisdale, Sask.	15
Henry Molded Pulp Products Inc.	Lebanon, Pa.	24
Keiding Inc.	Milwaukee, Wis.	n.a.
Keyes Fibre Co.	Albertville, Ala.	n.a.
	Hammond, Ind.	n.a.
	Sacramento, Calif.	n.a.
	Waterville, Maine	n.a.
	Wenatchee, Wash.	n.a.
Middleton Packaging Inc.	City of Industry, Calif.	15
Montrose Paper Inc.	Chicago, Ill.	82
Packaging Corp. of America	Griffith, Ind.	88
	Macon, Ga.	100
	Plattsburgh, N.Y.	40
	Red Bluff, Calif.	n.a.
Tekmold Inc.	Muskegon, Mich.	8
Woodstream Corp.	Lititz, Pa.	n.a.

n.a. = Not available.

PLASTIC RESINS AND CONVERTED PRODUCTS

Plastic resins and films are used in a variety of paper converting operations, and they represent the principal competition to paper and paperboard packaging. Polyethylene (PE), the largest-volume plastic resin in packaging, is used to make retail bags, garbage bags, milk jugs, soft drink bottles, food packaging, and a variety of other items. PE is also used by the paper industry for coating and laminating applications, and PE film is widely used for wrapping and bundling tissue products. Other major resins used in packaging include polystyrene (PS), polypropylene (PP), and to a lesser degree, polyvinyl chloride (PVC).

The U.S. plastics industry recorded a 7.2% gain in production and a 4.9% gain in sales volume in 1988, with total production increasing to 59.762 billion lb and apparent consumption in the U.S. increasing to 58.554 billion lb. Few observers expected the industry to match the record performance of 1987, a year in which resin consumption increased by 9.7%. Supply constraints slowed growth in 1988, but producers are now expanding capacity at a rate unseen since the early 1970s.

Average annual growth for plastics production during the past 25 years is about 7.5%. Plastics have replaced other materials in hundreds of applications, including food containers, carpet fibers, furniture, and automobile parts. Paper and paperboard products facing competition from plastics include kraft bags/sacks, milk cartons, folding cartons, paper cups/plates, composite cans, and corrugated containers.

U.S. PRODUCTION OF SELECTED RESINS

(million lb)

Year	LDPE[1]	HDPE[1]	PS	PP	PVC	Total industry
1988	10,397	8,400	5,187	7,274	8,350	59,762
1987	9,599	7,995	4,780	6,647	7,971	55,751
1986	8,903	7,182	4,470	5,812	7,256	50,848
1985	8,889	6,671	4,054	5,139	6,772	47,946
1984	8,413	6,085	3,838	4,940	6,760	46,336
1983	8,041	5,691	3,767	4,434	6,066	42,777
1982	7,503	4,928	3,191	3,477	5,326	36,607
1981	7,693	4,695	3,621	3,955	5,707	39,867
1980	7,291	4,405	3,521	3,648	5,470	37,347
1979	7,793	5,010	4,005	3,841	6,119	41,577

1. Includes LLDPE/HDPE swing capacity.

Source: Society of the Plastics Industry.

Packaging consumed over 13 billion lb of plastic resins in 1988—or 24% of total industry sales. Building and construction consumed 20%; consumer products, 9%; electronics, 6%; furniture, 5%; transportation, 4%; coatings/adhesives/inks, 5%; exports, 9%; and miscellaneous products, 18%.

Throughout 1988, packaging resins were in tight supply, and by year's end, plants were running at full capacity. Because of market tightness and the spiraling costs of chemical feedstocks, producers successfully raised prices of the major commodity resins by about 34% in 1988. Benchmark PE grades sold for as much as 51¢/lb at year's end, compared with 38¢/lb at the end of 1987. Producers of commodity plastics enjoyed one of the most profitable periods of modern plastics in 1987-88. Bolstered by these rising prices and by increased domestic demand, the industry is poised to expand capacity of the major commodity resins by nearly 25% between 1988 and 1991. This robust expansion follows nearly a decade of depressed prices, shakeouts, shutdowns, and overcapacity in the plastics industry.

Volatile market cycles are endemic to the plastics industry. In early 1989, producer prices began eroding. Benchmark PE grades that sold for more than 50¢/lb in the spring dropped to between 35¢ and 40¢/lb in the third quarter. The market was disrupted mainly by a sharp drop in exports to People's Rep. China and by a surge in new capacity. People's Rep. China, which had been putting in huge orders for PE and was the industry's fastest-growing export market, abruptly halted orders in early 1989. Buyers assumed that excess PE resins would be readily available and that prices had peaked, so they began to draw down inventories rather than order new product. Producer efforts to hold prices firm was undermined by increasing production capacity.

During the first half of the 1970s, the plastics industry initiated a similar series of expansion and debottlenecking projects as resin inventories became increasingly tight. Eventually, the expansions led to significant overcapacity, resulting in a downward trend in profits and lower prices for resins. These market conditions prompted several major petrochemical companies to sell their commodity plastic resin businesses. However, current activity suggests that resin producers are formulating their strategies more prudently, especially with respect to the four major resins: PE, PP, PS, and PVC. Despite periodic disruptions, most producers believe that over the long haul—across both the peaks and troughs of the business cycle—the plastic market will continue to expand.

With few exceptions, most major U.S. resin producers are diversifying their revenue base away from the cyclical commodity resin business and integrating production of downstream consumer products. Leading producers such as Amoco Chemical Co., Dow Chemical Co., Exxon Corp., Mobil Chemical Co., and Union Carbide Corp. have all made investments in recent years to expand downstream fabrication of value-added products and to increase their total market share. For example, Dow Chemical, which produces PE resins and film, moved into consumer goods with the development of Ziploc resealable plastic bags, a product worth $200 million in annual sales. Dow increased the value of its PE film by a factor of four when it was converted downstream into bags.

The short-term outlook for major-volume resins appears daunting, despite firm demand for most products. In 1989, resin output was expected to keep rising, but surplus supply and lower resin prices would probably eliminate profits for most producers. According to industry analysts, total U.S. plastic sales will increase 2.5% to about 60 billion lb, and capacity will increase to about 65 billion lb. Resin exports will also continue to rise, despite the drop in orders from People's Rep. China. The 1988 export volume expanded to 5.2 billion lb ($3.2 billion), and the 1989 level was expected to top 5.8 billion lb.

Every major plastic resin is expected to show solid grow[illegible] during the next several years. Plastic's penetration into the packaging market is being spurred along by the development of new plastic materials that provide equal or better performance at a lower cost per unit than other materials. However, these technological achievements are being overshadowed by the issue of solid-waste disposal.

Plastic's permanence in the environment (nonbiodegradability) and the low level of plastics recycling are major concerns for the future. Although plastic accounts for only 8% of municipal solid waste, it is the primary target of restrictive legislation because it is the fastest-growing segment of the packaging industry. While disposable PS-foam food containers and plastic bags have received the most negative publicity, several state and municipal governments are considering legislation to ban or tax any nonbiodegradable or nonrecyclable plastic packaging.

U.S. PRICE TRENDS FOR SELECTED RESINS

(¢/lb, 4th quarter)

Year	LDPE	HDPE	PS	PP	PVC
1988	51.0¢	51.0¢	58.0¢	49.0¢	43.0¢
1987	38.0	39.0	53.0	44.0	37.0
1986	28.5	32.0	35.0	34.0	29.0
1985	30.0	31.0	34.0	36.0	27.0
1984	30.0	32.3	37.0	35.0	24.0
1983	40.0	37.0	—	—	—
1982	27.0	35.5	—	—	—
1981	28.0	39.0	—	—	—
1980	34.0	37.0	—	—	—
1979	38.5	39.3	—	—	—

Source: *Modern Plastics.*

PLASTIC RESINS

Packaging comprised the largest category of resin sales in 1988—about 13.8 billion lb—but growth rates cooled considerably from prior years.

Among the major packaging resins, high-density polyethylene (HDPE), commonly used for plastic bags and sacks and blow-molded containers, increased production 5.1%, but sales remained flat at about 8.1 billion lb. Low-density polyethylene (LDPE), used for plastic coatings, films, and bags, increased production 8.3%, and sales grew 5.9%. PS, used for disposable food-service products and foam packaging, rose 8.5% in production, but sales increased only 3.4%. PP, which is used in injection-molded food containers and flexible packaging, increased production 9.4%, and sales grew 5.5%

Polyethylene. Strong market conditions have prevailed in recent years for this major resin group, which accounts for one-third of total plastic industry capacity. Nine of the 10 top U.S. resin suppliers have announced PE capacity expansions totaling 4.6 billion lb for 1988-91. Current PE capacity is about 20.1 billion lb. Of that amount, 8 billion lb is HDPE, 7.5 billion lb is LDPE, and 4.6 billion lb is capacity that can swing between linear low-density polyethylene (LLDPE) and HDPE.

HDPE output in 1989 was projected to remain flat at about 8.4 billion lb. Prices of blow-molding grades of HDPE rose 12¢/lb in 1988 to 51¢/lb. Demand for blow-molding resins is strong for milk and juice containers, liquid detergent bottles, motor oil bottles, and shipping drums. Some grades of HDPE resins are also used to produce plastic bags and sacks.

In 1989, LDPE and LLDPE output was forecast to drop about 3% to 10 billion lb. LDPE producers increased prices 13¢/lb in 1988 to about 51¢/lb. Although all PE resins are produced from ethylene feedstocks, LDPE margins are the most sensitive to ethylene prices, which increased sharply from 18¢/lb in the fourth quarter of 1987 to 32¢/lb at the end of 1988.

Demand for LDPE is strong for grocery sacks and retail bags, flexible food packaging, and shrink/stretch wrapping. Because of their lower prices, plastics have gained about 50% of the grocery sack market and 75% of the retail bag market. Heavyweight kraft paper grocery sacks sell for about $35 to $37/thousand sacks, while plastic sacks sell for about $22 to $24/thousand sacks. This price differential was expected to remain through 1989, leading to further market share loss by kraft paper, notwithstanding some consumer opposition to plastics.

LDPE is also widely used as a protective barrier coating on paper and paperboard substrates. In 1988, a total of 770 million lb of LDPE resins were used for coating applications, representing about two-thirds of total consumption of plastics coatings in the U.S.

Polystyrene. PS prices jumped 50% in 1987, caused mostly by soaring prices for benzene and styrene feedstocks. The upward price trend continued into the first quarter of 1988, as styrene feedstock prices reached a record-high level of 42¢/lb and pushed PS prices to 58¢/lb. Nonetheless, strong demand kept facilities operating at full capacity throughout the year, and supplies were tight for all customers. Prices dropped to about 56¢/lb in the first half of 1989. The forecast for PS growth in 1989 was approximately 3%.

PS producers are cautious of major capacity expansions, due to their narrow profit margins. Some expansions are planned for 1988-89, but they amount to less than 8% of the current industry capacity of 5.7 billion lb. One product that has boosted PS growth in food packaging is the fast-food clamshell container popularized by McDonald's Corp. Gains have been achieved in other fast-food disposables, resulting in the displacement of bleached paperboard cups, plates, and food containers. Egg cartons produced from PS resins have also dispaced molded pulp egg cartons. However, consumer and government opposition to PS foam products is on the rise.

Polypropylene. In 1988, PP prices increased 5¢/lb to 49¢/lb. This was half the rate of increase recorded in 1987. Efforts to raise prices early in 1989 were unsuccessful, and prices dropped sharply to about 44¢/lb. PP resins are used to produce injection-molded food containers and bottle closures and flexible packaging films. Demand was expected to grow about 6% in 1989. Some PP grades substitute for higher-priced resins during periods of high prices, such as in 1988. Between 1988 and 1991, nine U.S. producers plan to increase capacity by 2.4 billion lb from the current level of 7.0 billion lb.

PLASTIC PACKAGING

Food packaging is the largest segment of the plastics packaging industry, and plastic bottles and flexible films are the leading products in this segment. Plastic bottles and films are popular with food manufacturers because their barrier properties ensure freshness while preventing odors, moisture, or vapors from contaminating the product. In addition, plastic materials are lightweight, unbreakable, and often cheaper than other materials. Constar International Inc., headquartered in Chattanooga, Tenn., is the largest U.S. plastic container manufacturer. The company's subsidiary, Sewell Plastics Inc., acquired Owens-Illinois' plastic bottle division in 1987. Other major plastic bottle producers are Johnson Controls, Continental Can, and Amoco. Leading film producers include Quantum, Dow, Union Carbide, Chevron, Phillips, Exxon, and Mobil.

Plastic bottles have made significant inroads into tradi-

ESTIMATED CAPACITY OF TOP 20 U.S. COMPANIES PRODUCING PLASTIC RESINS

	Company	1988 annual capacity (million lb)	Major grades
1	Quantum[1]	4,260	LDPE, LLDPE, HDPE, PP
2	Dow	3,525	LDPE, LLDPE, HDPE, PS
3	Occidental[2]	3,050	LDPE, HDPE, PVC
4	Union Carbide	2,440	LDPE, LLDPE, HDPE, PVC
5	Himont	2,250	PP
6	Novacor[3]	2,100	LDPE, LLDPE, HDPE, PS
7	Exxon	2,010	LDPE, LLDPE, HDPE, PP
8	Chevron	1,955	LDPE, HDPE, PS
9	Phillips	1,915	HDPE, PP
10	B.F. Goodrich	1,750	PVC
11	Soltex	1,700	LDPE, HDPE, PP
12	Amoco	1,520	PP, PS
13	Shintech	1,500	PVC
14	Fina	1,460	PP, PS
15	Mobil	1,450	LDPE, LLDPE, HDPE, PS
16	Huntsman[4]	1,450	PP, PS
17	Eastman	1,400	LDPE, PP, PET
18	Allied-Signal	1,200	HDPE
19	Formosa	1,000	PVC
20	Georgia Gulf	850	PVC

1. Formerly USI Chemicals Div. of National Distiller & Chemical Corp.
2. Occidental Chemical purchased Cain Chemical's PE and ethylene plants in 1988.
3. Novacor Chemicals, a subsidiary of Nova Corp., a Canadian company, purchased Poysar in 1988.
4. Huntsman purchased Shell's 325-million-lb PP plant in 1988.

Source: *Modern Plastics.*

tional glass and paperboard markets, and plastic films have successfully taken market share from cellophane, paper, and paperboard. Plastic bottle demand is projected to grow over 5%/year and use 7.6 billion lb of resins by 1992, according to a forecast by Freedonia Group Inc. U.S. demand for plastic film is projected to increase 3.3%/year and consume nearly 10 billion lb of resins by 1992.

Among nonfood applications, one of the most competitive markets is grocery sacks, where kraft paper has traditionally been used. High-strength PE films have captured about 50% of the market—up from 5% in 1983. The leading plastic grocery bag producer is Sonoco Products Co., which also produces paperboard cores, cans, tubes, and plastic shipping drums. Sonoco produces about 6 billion plastic bags annually and has a 20% share of the 30-billion bag market. Its chief rival is Mobil Chemical, a subsidiary of Mobil Oil Corp., which produces about 4 billion bags annually. Sales of plastic grocery sacks are expected to increase at nearly 10%/year and hold 75% of the market by 1992, according to Kline & Co.

PLASTICS USE IN PACKAGING IN 1988

(million lb)

	LDPE	HDPE	PS	PP	PVC	PET	Total industry
Containers	290	3,585	1,130	482	366	980	6,981
Closures	32	89	196	305	39	—	681
Coatings	770	51	—	28	34	—	1,137
Film	3,219	534	220	605	320	—	5,006
Total	4,311	4,259	1,546	1,420	759	—	13,805

Source: *Modern Plastics.*

ELECTRONIC COMPETITION

Advancements in office electronics and electronic communications have created two seemingly contradictory outcomes: people are using less paper, and people are using more paper. What has really happened is that the world's romance with "seeing it in print" has grown, perhaps in response to the otherwise transitory nature of society. Fears of the paperless office have mostly been offset by technology that actually encourages use of more paper (whether intentionally or not). These technologies include computer printers, advanced photocopiers, and facsimile machines.

It was not long ago that the paper industry feared a reduction in paper demand because of advances in electronics, especially electronic data interchange (EDI). It is quite obvious now that the wholesale elimination of paper from daily use is not likely in the foreseeable future, and large reductions in paper usage and consumption may be a decade or more away.

Services such as Teletext, videotext, electronic mail, and CD-ROM (compact disk/read-only memory) help eliminate certain paper transactions. Prodigy, a joint-venture between IBM and Sears that offers both information and shopping services through personal computers, seems to be gaining ground as the services expand. Another area that has affected marketing are televised home-shopping services, though their long-term popularity has ebbed and flowed with the economy and the whims of viewers/customers.

All of these electronic transactions generate paper at some point in their process, including shipping labels and

ELECTRONICS-RELATED SPECIALTY PAPERS: U.S. MARKET SIZE AND STRUCTURE

(tons)

Grade	1988	1989	1990	1991	1992	1993	Compound annual growth 1988-93
IC/P*	1,113,630	1,358,410	1,592,580	1,829,350	2,067,730	2,279,580	15%
Ink jet	24,170	38,790	58,260	76,790	81,410	79,540	27
Thermal transfer	4,010	4,220	4,110	4,060	4,110	4,130	1
Total	1,141,810	1,401,420	1,654,950	1,910,200	2,153,250	2,363,250	16
Facsimile papers							
Thermal	19,990	35,090	48,540	61,100	74,440	92,850	36
Plain paper	2,030	4,410	8,400	14,610	22,780	33,290	75
Other coated	100	40	0	0	0	0	-100
Total	22,120	39,530	56,940	75,710	97,230	126,140	42

Note: Figures include both cut-size and continuous forms.
* = Intelligent copiers/printers, including laser.

Source: BIS CAP International, Inc.

invoices, charge receipts, product and mail packaging, and product literature, not to mention the paperwork generated for returns and shipping delays. Thus, the real issue, at least in the short term, is the shift in grade mix. Desktop publishing and personal computers have pushed up demand for quality cut-size papers, replacing, for example, coated specialty paper used in photo typesetting machines. This holds true particularly for newsletters, because they can be produced more easily on cut-size paper than, say, newspaper advertising inserts. Subscriber copies of some newsletters are even produced on copying machines, bypassing the commercial printer (and consequently, uncoated offset paper) altogether. Desktop publishing is also being used to provide camera-ready copy for some magazines, catalogs, and brochures, which eventually are printed on high-quality uncoated or coated papers. This trend will continue as computer page printers produce increasingly better-quality type and graphics.

Placements of personal computer printers in the U.S. are expected to jump from 5.64 million in 1987 to 7.62 million in 1992, according to CAP International Inc., a Norwell, Mass.-based market-research company. Datek Imaging Services, a CAP unit, said in its 1989 annual statistical report that demand for printer paper will grow from 683 billion pages in 1986 to 931.5 billion pages in 1991—a 6% cumulative average growth rate. Cut-size paper (usually 8½ x 11 in.) will continue gaining market share at the expense of continuous computer paper. In fact, Datek said, cut-size paper will grow at a 27% cumulative rate, and by 1991 it will account for 30% of pages consumed by computer printers. Multi-part custom continuous forms will decline by 3% and stock continuous by 1% cumulatively during the same period, Datek said.

Uncoated free-sheet bond represented 94% of all U.S. shipments to business forms converters in 1988, while uncoated groundwood, at 170,000 tons, made up most of the balance. Groundwood paper dropped 25% from just one year earlier.

Major suppliers of laser printer papers include Boise-Cascade Corp., the Hammermill unit of International Paper Co., James River Corp., and Mead Corp.'s Gilbert Paper Co. Perhaps the greatest opportunities for these mills are in electronic publishing, which so far has only 4% penetration in the business community.

Office equipment manufacturers (OEMs) predict that within five years, laser printers will match the quality of professional typesetting equipment, pushing laser printers ahead even more.

Demand for office specialty papers is expected to double in the U.S. between 1987 and 1992, one study noted. Demand for these grades, which include computer printer and thermal papers, will rise from 134,000 tons in 1987 to 249,000 tons by 1992. Sales will jump from $931 million in 1987 to over $1.8 billion by 1992.

Demand for bond and writing papers has grown tremendously in the last 20 years. Annual shipments rose from 372,000 tons in 1960 to 2.8 million tons in 1988. The U.S. market rose over 7% in 1988 from the year before.

Color copies—and more. The cut-size copier market is also expected to grow rapidly. Consumption will increase at a cumulative annual growth rate of 4%—from 316.5 billion sheets in 1986 to 378.6 billion sheets in 1991, according to the Datek report. Personal copying and that done by retail copy shops will both post 11% growth rates.

OEMs are introducing new copiers with technological advancements (e.g., in color xerography) requiring unique, high-quality papers. But not all OEMs are out hunting for paper to meet their technologies. Mead Corp. invented both a process and a paper/film substrate to go with it, then tried to interest OEMs in its new Cycolor process. So far, Mead has been relatively successful.

POTENTIAL IMPACT OF TELETEXT ON MAJOR PRINTING PAPER GRADES

Paper grade	Potential positive impact	Potential negative impact
COATED PAPERS		
Coated groundwood and coated free-sheet	Magazines, brochures, promotional advertising, operating manuals, books	
Thermal papers	Printer output	
UNCOATED PAPERS		
Uncoated groundwood	Videotext directories	White telephone directories
Newsprint		Decline in classified use
Forms bond	Printer output	
Uncoated free-sheet (other)	Books, operating manuals	
Check paper		Less check use

George Treier, principal engineer for Xerox Corp., told delegates at *Pulp & Paper*'s White Papers and Office Automation Conference in April 1989 that new printing technologies put greater emphasis on:

1. Systems and post-imaging applications that require customized applications using a range of basestocks, and preprinted and perforated papers.
2. Higher-speed and higher-resolution xerography, using laser imaging and electronics.
3. Color xerography.
4. Ionography.
5. Inkjet technology in the low and low-medium usage segments—black and white as

well as color.

Fax machines come of age. Sales of fax machines, which are quickly becoming standard in not only offices but also in retail businesses, copy shops, and even homes, are likely to continue growing strongly.

"The facsimile industry is growing at a tremendous rate," said Robert Stover, marketing director/facsimile for Harris/3M, a fax machine marketer. Placements of fax machines increased by 500,000 in 1987, up about 37% from the previous year. Higher growth is expected each successive year. About 98% of those machines use thermal paper, and the rest use standard bond or other papers.

U.S. thermal paper capacity has been expanding, although strong U.S. demand also means increased imports, primarily from Japan. North American demand for direct thermal paper was approximately 89,000 tons in 1989, according to Arthur S. Diamond, president of Diamond Research Corp. of Santa Barbara, Calif. Diamond presented his conclusion at the *Pulp & Paper* White Papers and Office Automation Conference.

The market is therefore rather small compared to commodity-oriented areas (cut-size, offset, etc.), but thermal paper use will grow by 50% in just three years, according to Tom Ashley, director of hard copy materials at CAP International. CAP said the largest part of the thermal papers market—facsimile—will grow 149% from 1986 to 1991. Fax use accounted for 29% of the thermal paper end-use mix in 1986, and its share will rise to 49% in 1991.

The other major growth area is label paper, which is used for such applications as bar codes on wrapped-to-order supermarket foods (similar to the preprinted universal product codes [UPC] on packaged goods). Labels are also used by basic manufacturers, especially automakers, for inventory control. Thermal label paper use will increase by 61% during the 1986-91 period. A more conservative (though still hefty) figure is offered by Keiji Endoh, chairman of Ricoh Corp., the North American unit of the Japanese office equipment manufacturer. Endoh said that the North American market for thermal fax paper is expanding at 30% annually.

Chart paper (e.g., electrocardiogram readouts) will increase 34%, and tag ticket (e.g., United Airlines' bristol-based automated ticket/boarding pass, which uses thermal transfer bar coding) will grow 40%. On the losing end of market share is computer and other printer papers, which could decline 41% by 1991, CAP said.

Thermal paper is a value-added product, usually selling for about two-and-a-half times the cost of similar-quality paper. Most thermal paper basestock is uncoated free-sheet.

Appleton Papers Inc. currently is North America's major producer of thermal paper. The company recently tripled its heat-imaging paper capacity with construction of a high-speed thermal paper coater. The company now has 11 coating machines at the Appleton, Wis., plant. The addition will help Appleton compete with Japanese companies, which are collectively the major market force. (Virtually all fax machines, or at least many of their major components, are also manufactured in Japan.)

Appleton, with approximate 1989 capacity of 45,000 tpy, accounts for about 49.2% of total U.S. capacity, according to Diamond. He estimated that other thermal paper capacities were: Kanzaki Specialty Papers, 15,000 tpy; Ricoh Corp., 12,000 tpy; Labelon Corp., 10,000 tpy; Nashua Corp., 5,000 tpy; 3M Co., 2,500 tpy; and others, 2,000 tpy.

Ricoh, which claims to be the pioneer in development of the modern fax machine, is expanding its capacity in the U.S. through addition of a new converting plant in Georgia and licensing of its technology to Azon Corp. of Johnson City, N.Y. Azon will produce about 3,600 tpy of fax paper. In addition, the company's Ricoh Electronics Inc. subsidiary, which has manufactured thermal labels for point-of-sale systems since 1985, began making fax paper in August 1989. (Ricoh also licenses its technology to Renker GmbH & Co. KG of Fed. Rep. Germany.) Endoh predicts that Ricoh "will be able to supply about 20% of the North American market for high-sensitivity thermal paper by 1990,

MAJOR PAPER GRADES AFFECTED BY ELECTRONIC COMPETITION: U.S. SHIPMENTS

(000 short tons)

Grade	1988	1987r	1986	1983	1980	1975
Newsprint	5,982	5,842	5,630	5,167	4,672	3,691
Groundwood specialties						
Directory	643	605	600	450	450	300
Catalog	n.a.	540	540	425	375	300
Groundwood forms	173	230	325	240	230	75
Groundwood book	82	65	70	125	130	130
Uncoated free-sheet						
Forms bond	2,123	2,133	2,100	1,700	1,500	950
Envelope stock[1]	933	907	850	700	660	460
Offset book	2,836	2,736	2,634	2,210	2,000	1,450
Bond and writing	2,804	2,619	2,375	1,840	1,800	1,000
Tablet	393	425	400	400	325	230
Coated paper						
Nos. 1 to 4, two-side	2,645	3,150	2,760	2,300	1,800	1,200
No. 5, two-side	3,478	3,300	3,120	2,960	2,400	1,650

1. Does not include brown, bleached, or semibleached kraft envelopes.
r =Revised.
n.a. = Not available.
Sources: *Pulp & Paper* estimates; Newsprint Information Committee; Canadian Pulp & Paper Assn.; American Paper Institute.

POTENTIAL IMPACTS OF ELECTRONIC AND COMPUTER TECHNOLOGY ON PAPER CONSUMPTION

	Use	Equipment	Grades and end uses affected
MESSAGES			
Electronic mail	office	microcomputer and modem	some loss in first-class mail and copy paper
Voice mail	office	same as above	same as above
Facsimile	office	fax equipment	specialty papers; some loss in first-class and express mail
Colored copying	office	special copiers	specialty papers
Work office	office/home	word processors, microcomputer	copy, bond, forms
INFORMATION			
Database + optical or magnetic storage disks	directories, catalogs	microcomputer coupled with up-to-date database	forms, groundwood papers, business-to-business directories and catalogs
Wide-area networks	telephone directories, interchange of data	microcomputer or telephone-supplied equipment coupled with mainframe computers	telephone directories
Videotext	a. general information b. news/editiorial c. classified advertising d. electronic shopping	microcomputer coupled with mainframe computers with large databases	a. forms, publications b. newspapers, magazines, references c. newspapers d. catalogs/coated, groundwood papers
Optical/magnetic disk storage	office files and records	scanners and optical/disk storage, plus microcomputers	label, security papers, copy, file folder, index
Electronic data interchange (EDI)	invoicing, purchasing inventory, financial reporting	computers	forms, business papers
OCR/MICR	banking, inventories, sales	scanners, computers	label, security papers, forms
PUBLISHING			
Desktop	offices, small publishers	microcomputers, laser printers	copy, coated
Videotext	home	microcomputer coupled with large databases	books, magazines
Laser printers	office	non-impact printer	bond/copy, forms
High-resolution TV	home	TV receiver	less print

compared to Appleton's approximately 50% market share."

Kanzaki has additional capacity in Japan, as does Oji Paper (about 9,000 metric tpy) and others. Diamond expects U.S. demand for direct thermal papers to reach about 89,000 tons in 1989.

One reason fax machines are being used in more and more offices is that, like personal computers, their technology improves while prices decline, said Stover of Harris/3M. Many fax machines now sell for around $2,000, and some are available for $500 to $1,000. These new machines are many times faster than the older generation, which took about six minutes to complete a transmission and cost $200/month to rent. About 70% of the new machines are sold to first-time buyers.

Catalogs go electronic—sort of. Another area of potentially long-term competition is catalogs. Sears is part of the Prodigy information systems, whose users can order merchandise from Sears (and other vendors) via computer. Another major catalog retailer, Spiegel Inc., has had some success selling its video catalogs. Video catalogs cannot actually be ordered from, according to *Catalog Business*, an industry magazine. The videos are shipped with the paper catalog as an enhanced selling tool. Videos can be purchased or rented.

Several reference book publishers have introduced electronic versions. *Oxford English Dictionary*, Britannica's *Compton's Multi-Media Encyclopedia*, and Grolier's *Academic American Encyclopedia* are available on CDs that can be read by a personal computer with a CD-ROM drive. Though less expensive than the printed version, the Grolier CD does not have photographs and illustrations. Grolier, possibly the third-largest encyclopedia publisher behind Britannica and World Book, is also working on a CD-interactive system that will have sound, motion, and illustrations. The company expects widespread acceptance to take ten years or more, without having a major effect on total use of paper.

Most word-processing programs now come with spelling checker/dictionaries, replacing some of the need for printed versions. However, books often contain many more words—and definitions—than do their software counterparts. *Publisher's Weekly* said that the electronic dictionary may get a boost from inclusion of the *Webster's Dictionary* database in the Next computer. The second edition of the *Random House Dictionary* is also being put onto a database. Of course, computers are used to produce major reference works because databases can be updated faster and more accurately.

Microsoft Corp., publisher of the word-processing program "Word," has gone a couple of steps further and developed a package called "Bookshelf." The package contains ten programs, including *World Almanac and Book of Facts*, *Bartlett's Familiar Quotations*, *American Heritage Dictionary*, a zip code and post office directory, *Business Information Sources*, *Chicago Manual of Style*, Roget's II Electronic Thesaurus, and two others. Under ideal conditions (computer compatibility, etc.), information from these "books" can be imported into a working document.

Telephone directories are also showing up in electronic form. A company called SilverPlatter Directories Inc. sells CDs containing about 100 million U.S. residential and business telephone and address listings, according to *Business Week* magazine. Unlike telephone books, which usually are free or very inexpensive, the SilverPlatter disk set costs almost $3,000. It is easier to use, however, for activities such as compiling mailing databases that need to be easily broken out by various demographic criteria.

Regional Bell operating companies (RBOC) are anxious to expand their own data services because printed telephone directories face competition from electronic information services. Some industry observers estimate that between 20 and 30 million households could use these services by 1990.

Business or consumer-oriented electronic information exchanges utilizing personal computers have been started in Canada by Tele-Direct (Publications) Inc., the publishing arm of Bell Canada Enterprises Inc. The French national telephone company has had success with MiniTel, an inexpensive electronic directory system that is combined with videotext service. The company plans to replace all telephone books with electronic terminals by 1995. Terminals are distributed free of charge through the post office, but only on short-term loan. In addition, the U.K. has had paltry success with Viewtel, an electronic newspaper service.

In the U.S., phone-in yellow pages services offer free, updated advertising information to callers. Consumers call for a telephone number, or they can be connected directly with a person or business. One talking-yellow-pages entrepreneur brazenly predicted "it will affect [printed directories] to the point of extinction."

Call-in or other electronic yellow pages services benefit from the biggest inherent disadvantage of the printed versions--non-printed listings can be updated frequently. On the other hand, published directories have the distinct advantage of presenting all the listings together rather than making available just a few at a time. Still, RBOCs are expected to get into the electronic side of the industry at some point.

Business forms industry changing. The business forms industry is also most affected by advancements in electronic information generation. It is estimated that the business forms industry may decline 10% over the next several years, as complex (and profitable) forms for bills of lading, purchase orders, etc., are replaced by electronic data interchange. For example, perhaps 30% of overnight package service traffic consists of documents that are vulnerable to replacement. Also, some courier services are replacing multi-part shipping forms with single-part forms for at least their large customers.

In addition, many companies now use forms generated in-house with computer software and high-quality computer printers. Dataquest expects the market for forms processing software to be $359 million by 1992.

International Business Forms Industries Inc. (IBFI) devoted the July 1989 issue of its *FormsMfg.* magazine to the subject of EDI and how it affects the forms industry. In that issue's commentary, William B. Hull, manager-advanced technology development for The Standard Register Co., said that companies using EDI report substantial cost savings. Verne Royster, director of Reseller Sales Div. of FormMaker Software Inc., said in the same issue that for every dollar corporations spend on forms procurement, they spend an additional $20 on storage of the finished product. Hull said that currently only about 5% of the world's business transactions are electronic, though he adds that even paper companies encourage customers to use EDI to make paper purchases.

"Electronic" forms are benefiting from advancements in intelligent copiers, computer printers, and forms-generating computer software, said John S. Rosenberg, associate editor of *FormsMfg*. These advances allow forms design on demand. EDI usage usually results in falling demand for multipart and custom continuous forms made by converters.

The magazine also noted that paper companies are marketing value-added premium papers for laser printers and intelligent copiers. In addition, it said the business papers market will continue to grow substantially.

EDI—FRIEND OR FOE?

Perhaps 75% of all Fortune 500 companies now have corporate videotext systems installed. Optimistic estimates put videotext growth at 69% annually, representing a $2- to $3-billion industry by 1996. However, even people in the EDI industry think that is much too rosy a scenario.

Big players in EDI include General Electric Information Services Co., McDonnell Douglas Corp., IBM, AT&T, and Control Data Corp. There are also database and bulletin board services such as CompuServe and The Source, several newspaper publishing companies such as the Dow Jones News Retrieval, and the electronic mail services of MCI and Western Union.

The growth of electronic funds transfers (EFT) in banking sometimes eliminates the need for paper transactions either between institutions or between customer and institution. Of course, many EFTS are later confirmed on paper in monthly statements. Automated teller machines (ATM) reduce some internal institutional paperwork, but ATMS issue paper receipts for their transactions. It will be at least five to ten years before EFT becomes a significant factor in reducing paper demand.

To read or not to read. Television is the most noticeable technology to affect print. Newspaper publishers and editors often decry the fact that most people today get much of their information from TV rather than from newspapers.

Newspaper managers are wary of computer- and telephone-based information services. Yet, a newspaper industry analyst said there is little evidence the new electronic media will have an appreciable effect on newspapers and newsprint consumption through 1995. EDI could eat into the classified advertising segment of the business, which *Editor & Publisher* magazine calls a lucrative and essentially exclusive service of newspapers.

U.S. newsprint consumption (30-lb basis weight) increased about 2.3% annually from 1978 (nearly 10.9 million short tons) through 1988 (almost 13.6 million tons). Growth should drop slightly during the period from 1988 to 1997, at which time consumption will reach about 17.3 million tons.

EDI has so far failed to severely hamper newsprint growth because much of the U.S. population does not own or use computers. Electronic communications technology (hardware and software), although declining in price, is still fairly costly. Many consumers are willing to spend hundreds or thousands of dollars for television and sound equipment, but not for computers, which tend to be used less than TVs and stereos.

In addition, utilization of electronic media requires considerably more effort from the user. Getting just 10% of the information contained in a typical daily newspaper would require more time than is required to read the newspaper. Radio and television are passive systems even simpler to use than newspapers.

Magazines. Electronic data and images have affected the magazine industry, primarily in the "news" end of the business. While newsweeklies and other general-interest magazines have lost readership, special-interest magazines continue their strong growth. Many special-interest periodicals use high-value paper, especially coated free-sheet. Others, which care less about looks, use lower-end papers such as newsprint and groundwood specialties.

Paper companies are themselves adopting electronic data exchanges in the forms of EDI, electronic mail (E-mail), online transaction processing (OLTP), and fax. Paper companies also rely on bar coding for inventory control and distribution.

Major papermakers taking advantage of electronic data exchange often come from the printing papers side of the business, such as International Paper and its Hammermill Paper Div., Westvaco Corp., Appleton Papers, Champion International Corp., and Great Northern Nekoosa Corp.'s Nekoosa Papers Div. Containerboard companies also began using electronic data exchanges during the last few years.

Various trade groups and standards associations are currently working to establish uniform standards for business data transmission.

PULPING AND PAPERMAKING CHEMICALS

The paper industry worldwide is facing unprecedented pressure from governments and environmentalists to reduce the production of chlorinated organic byproducts from the kraft bleaching process. In addition to prompting widespread process changes in kraft pulping and bleaching, these pressures have also led to a new wave of chlorine-free paper products utilizing unbleached pulps or pulps (such as bleached chemi-thermomechanical pulp [BCTMP]) bleached without the use of chlorine. One of the most common process changes taking place to reduce chlorinated organics in mill effluents is high-level chlorine dioxide substitution in the chlorination stage. This movement is causing a boom in the sodium chlorate market and painting a dismal future for chlorine markets.

The outlook for chlorine will do nothing to ease the tightness in the caustic soda market, a coproduct in chlorine production, just recovering from two years of inadequate supply. Other major external factors affecting the paper industry and paper chemicals markets are a strong U.S. dollar, a weaker economy, and changes in foreign consumption, especially in the Far East.

PULPING CHEMICALS

Chloralkali. Chlorine, produced in conjunction with caustic soda (sodium hydroxide) from the electrolysis of sodium chloride, has long been the standard chemical used in the initial bleaching stage of bleached kraft pulp manufacturing. However, massive changes are currently taking place in chlorine consumption as bleached kraft mills move to reduce levels of chlorinated organics in bleach plant effluents. Although many fears are unfounded concerning the minute levels of dioxins found in mill effluents and biota in surrounding waters, public opinion and governmental pressures are causing all mills making bleached grades to alter their operating technology to conform with newly established or anticipated legislation.

The most common step is the substitution of chlorine by chlorine dioxide at levels of 50% or greater. Industry-wide substitution levels are expected to reach 70% by 1992. As a result, industry analysts and leading producers are predicting that chlorine consumption may fall by as much as 50% over the next five to six years, a situation that could bring about major changes in the chloralkali industry in terms of both prices and technology. Chlorine producers are hoping that growth in the polyvinyl chloride (PVC) market will offset the slumping paper industry market. At least one producer sees that as uncertain, however, because of growing consumer concerns over any products containing chlorine. Pulp bleaching currently accounts for about 17% of the chlorine demand in North America, slightly below the PVC market at 21%. In terms of price, heavy discounting has occurred in both contract and spot markets, a trend that is likely to continue.

On the caustic side of the market, suppliers are exploring alternate production technologies to cushion the impact of a serious chlorine slide. Tenneco and FMC are both studying the use of soda ash for chlorine production. Although less alkaline, soda ash may also be used as a direct substitute for caustic in some processes. Exact figures are not available, but interest in soda ash substitution is thought to be on the rise in the paper industry. Prices for caustic, which have remained relatively stable compared with 1988's desperate market, were beginning to rise toward the end of 1989 as producers tried to compensate for lower chlorine prices. Industry giants Occidental Chemical and Dow Chemical U.S.A. announced off-list price hikes of \$20/ton for both spot market and contracts (as terms permit), bringing the cost of 50% industrial grade caustic up to \$265 to \$375/ton in third-quarter 1989.

Soda ash. Several major expansions were announced in the soda ash market in 1989. Three of the industry's biggest producers—General Chemical (300,000 short tons), Tenneco (100,000 short tons), and Texasgulf (200,000 short tons)—all announced plans to increase capacity in the wake of an increased demand for soda ash, part of which is due to the tightness in the caustic market. Exports were also up for the year (about 10%) due to increased demand in Japan and generally higher prices in foreign markets. Producers have been getting up to 33% more ($123.69 vs $93.00/ton) for soda ash overseas, making the export markets attractive. A minor market player, Lake Minerals (subsidiary of Cominco American), in a joint venture with Vulcan Materials of Birmingham, Ala., is considering building a new plant at Owens Lake, Calif. Estimated capacity would be 500,000 short tpy.

Domestic capacity for soda ash in second-half 1989 was over 10.5 million short tpy, while estimated domestic consumption for 1989 was between 7.5 and 8.0 million short tons, according to the U.S. Bureau of Mines. Demand in Canadian markets is about 450 kilotons/year (496,000 short tpy). Several other industries are large consumers of soda ash, including glass, plastics, and aluminum.

Sodium chlorate. Sodium chlorate was one of the busiest sectors in paper chemicals in 1989 because of the movement by the paper industry to substitute chlorine dioxide for chlorine to reduce chlorinated organic byproducts in bleach plant effluent. Prompted by double-digit growth in consumption and forecasts of the same over the next several years, all major sodium chlorate suppliers in the U.S. and Canada have announced expansions, greenfield sites, or both. Together, these projects represent additional capacity of about 725,000 short tpy by 1992. At that time, industry analysts expect the market to be back in balance, or slightly over capacity, depending on the strength of the movement toward oxygen delignification. Over the short term, however, the market is expected to be fairly tight. Consumption figures for 1989 were estimated at approximately 840,000 tons, with about 550,000 tons being consumed by U.S. paper mills. Consumption is expected to rise to about 1.2 million tons by 1993.

Historically, the price for sodium chlorate has remained stable, partially because it is relatively cheap to produce. Today's market conditions, however, could change that scenario for a brief period because paper mills are being forced by environmental regulations to make changes in bleaching technology, causing a rapid increase in demand. One industry analyst indicated that as a result, discounting has dropped dramatically. Another analyst concurred, mentioning that the spot market could become chaotic over the next year, especially if there are any unexpected delays in the expansion projects now under way.

Two major suppliers, Occidental Chemical and CanadianOxy Industrial Chemicals LP, have joined forces to make Canadian Oxy's chlorate supply available to OxyChem's U.S. customers. Prompted by huge increases in demand in the U.S. coupled with lower power costs in Canada, the reported long-term agreement should ensure both companies a place in the lucrative chlorate market for some time.

Hydrogen peroxide. The hydrogen peroxide market enjoyed the largest growth of any commodity chemical during 1989. Growth was so widespread that four of the five major suppliers in North America announced expansions or plans for new facilities during the year, and all five declared the first significant price increase in five years. Worldwide hydrogen peroxide markets grew by about 6%, while the North American market grew by 15% to 18%, primarily a reflection of the dramatic 28% increase in consumption by the paper industry.

In addition to growth in local markets, many producers are looking overseas. Partnerships have been formed (five in Latin America and the Pacific Rim alone) and expansions have been announced by key participants in Venezuela, Thailand, Indonesia, New Zealand, Sweden, and the Netherlands. Several areas other than paper are demonstrating tremendous growth potential, including environmental applications, waste treatment, electronics, and food and chemical processing. Some industry experts feel that environmental applications, especially detoxification of hazardous wastes, will be the second-largest user during the 1990s and could challenge paper industry consumption in the next ten years.

The growth in paper industry consumption, fueled by increased use in the BCTMP market and, to a lesser degree, by the growing trend of chlorine substitution in kraft bleach plants, is expected to continue at about 15% annually through

CHEMICAL CONSUMPTION BY U.S. PULP AND PAPER ESTABLISHMENTS IN 1982 AND 1987

(000 short tons)

Chemical	1987	1982
Sulfur	299.4	271.3
Chlorine	1,606.0	1,334.9
Sodium hydroxide (caustic soda) (80% sol.)	2,825.9	2,153.4
Sodium sulfate, including saltcake (100% Na_2SO_4)	509.8*	905.4
Sodium chlorate (100% $NaClO_3$)	442.4	309.5
Aluminum sulfate (17% Al_2O_3)	526.0	481.0
Titanium dioxide**	414.1	310.7
Rosin sizing**	263.3	267.1
Lime	1,506.3	1,172.0
Kaolin and ball clay	2,672.7	2,271.9
Starch**	2,039.8	1,720.6
S/B latex**	272.6	n.a.

n.a. = Not available.
* = Bureau of Census estimate.
** = Million lb.

Source: Bureau of the Census, Census of Manufactures.

1994, according to several estimates. Consumption in the paper industry for 1989 is estimated at about 160 million lb. That figure will grow to 190 million lb in 1990 and to between 260 and 320 million lb by 1992, although these estimates may be conservative depending on developments in the kraft bleaching segment. Consumption in Canada is expected to grow at about twice the rate of the U.S. because of the rapid growth in the BCTMP market.

Current capacity in North America is approximately 520 million lb/year. New plant construction and expansion projects under way will add 239 million tpy by 1991. While the balance between supply and demand caused little concern in early 1989, later reports indicated a growing tightness in a market already running at full tilt. Much like the sodium chlorate market, the hydrogen peroxide market's fast-paced growth is quickly catching up to available supply. Much of the announced new capacity will not come online until mid-1990 to mid-1991, resulting in forecasts of a tight market for the next 18 to 24 months.

Prices were stable for most of 1989 until FMC announced a 5% to 6% hike in list prices in mid-July. The four other major producers (industry leader Interox America, DuPont Canada, Degussa, and OxyChem Canada) quickly followed suit with nearly identical rate hikes, all effective Aug. 1. Reasons cited for the increase included rising raw material costs and additional costs to service customers (transportation, technical service, distribution networks). Technical grade product prices ranged from $0.245 to $0.48/lb, depending on concentration.

Oxygen. The North American paper industry is one of the fastest-growing markets for industrial oxygen use. While about 75% of bleached kraft mills in Canada and about 80% in the U.S. use oxygen to supplement the first extraction stage (oxidative extraction) in their bleaching sequences, the amount of oxygen used is relatively small (about 10 lb/ton) compared with the charge required for oxygen delignification (80 to 100 lb/ton). Oxygen delignification has been identified by industry experts as a key element in achieving significant reductions of chlorinated organic compounds produced during the bleaching of kraft pulp, and it is a market that continues to gain momentum. In 1989, 19 systems were ordered or proposed in North America, and more are anticipated as mills devise plans to improve effluent quality.

Another method being implemented to address effluent quality issues that also impacts the oxygen market is secondary effluent treatment. It is required (by 1992) in British Columbia and is also considered by some experts as a necessary step (in addition to oxygen delignification and chlorine dioxide substitution) to reach the dioxin level of 1.5 kg/ton of pulp produced that is required by 1994 in that province. The upside is that if a mill opts for onsite oxygen generation to supply the oxygen delignification system, the oxygen plant can be sized to supply the secondary effluent treatment system as well (or vice versa). Several mills are installing systems designed with this in mind. Capacity figures for oxygen are not readily available, as it may fall into one of several industrial gas classifications, depending on use and distribution arrangements.

PAPERMAKING CHEMICALS

Titanium dioxide. The North American titanium dioxide market remained tight during 1989 as producers scrambled to keep up with the growing demand. All four U.S. suppliers announced or completed expansion projects that were aimed at capturing the growing demand in the paper industry and in the plastics industry, which for the first time surpassed the paper industry as the world's second-largest consumer. Paints and coatings remain the largest market, consuming more than 50% of North American production.

While the paper sector continues to grow (mainly due to the growing markets in lightweight-coated and coated freesheet grades), titanium use is receiving considerable competition from alternate fillers and extenders—especially calcium carbonate—as the industry continues its conversion to alkaline papermaking. Revised consumption data show that the paper industry used between 240,000 and 290,000 tons during 1988 (depending on the source consulted), or about 24% of the market. Titanium slurries reportedly make up 70% of that total. Estimates for 1989 put paper industry consumption at 246,000 to 295,000 tons, or an increase of about 2.7%.

The total U.S. demand for 1988 was 1,092,979 short tons. Estimates for 1989 demand were in the range of 1.096 to 1.1 million tons—an increase of approximately 3%. By comparison, U.S. production figures were 1,021,560 short tons in 1988 and an estimated 1.086 million short tons for 1989. Imports of the pigment were down slightly (2.9%), while exports jumped 27.9%—another factor behind the tightening of an already short market. Prices for rutile and anatase grades were listed at $1.03 and $1.00/lb, respectively—a 5% to 6% increase over year-end 1988 prices of $0.97 and $0.95. The 1989 hikes were a major moderation of the 18% to 23% price increases during 1988.

Although worldwide expansions of approximately 900,000 tons (through projected 1993 startups) are on the boards, some industry analysts are predicting that a few sectors will remain tight because of the growing regional markets and the increased pressures to close down facilities that are using the "environmentally unfriendly" sulfate manufacturing process. Overall, however, the titanium dioxide market is expected to ease as the paper industry adopts a slower growth pace.

Calcium carbonate. The demand for calcium carbonate in North America showed an increase of more than 15% during 1988-89, according to several manufacturers. This double-digit growth, which could possibly go as high as 20%, should continue into the early 1990s as alkaline production continues to increase. Consumption is expected to grow for both precipitated and ground grades as the paper industry continues converting from acid to alkaline papermaking, which now stands at approximately 30% of capacity. That figure is expected to increase to at least 50% by the early 1990s, and the possibility exists of total conversion to alkaline papermaking by the year 2000.

Pfizer, with its onsite precipitated calcium carbonate (PCC) facilities, has dominated recent growth in the filler segment, while ultrafine ground calcium carbonate (UFGCC) still owns the coating market. Development of new products, such as cationic grades, and increasing filler levels may help to fortify the ground calcium carbonate market.

North American capacity of precipitated $CaCO_3$ (PCC) was expected to reach more than 600,000 tpy by the end of 1989 as several new onsite plants were scheduled for startup. This figure represents a 20% to 25% increase over 1988 levels. Some overcapacity has been reported in the ground market, and discounting was taking place. However, analysts are anticipating future price increases and less discounting as alkaline papermaking continues pushing demand to record-high levels.

Kaolin. Net gains have been realized over the past two years in the kaolin market, resulting from the strong growth in many paper market segments, despite the trend of alkaline conversions and the replacement of clay with calcium carbonate. Slower growth of the industry and competition from calcium carbonate should ease what had been a fairly tight market since early 1988.

Nevertheless, five major suppliers announced expansions that total about 700,000 tpy. In addition, several companies are also developing new products to compete in the alkaline market, including calcined products.

Alum. Although the use of alum continues to slide at an annual rate of 2% to 3% in the wake of the soaring alkaline market, the demand for alum in some market segments grew during 1989. Increased demand for fine paper and some unbleached grades was principally responsible for this growth. In spite of the downward trend in alum use, several suppliers announced healthy price increases during 1989. Consumption in the U.S. in 1989 was estimated at about 650,000 lb (liquid basis).

WORLD REVIEW

Yet another year of record output by the world's pulp, paper, and board producers, 1988 was the sixth in a row. However, sad signs indicate that the industry's longest boom period may be drawing to an end. While output and consumption are likely to carry on upward, they will be moving up more slowly than in the past six years. This, in addition to new production capacity, may mean that some papermakers will get hurt.

The world made 226,357,000 tons of paper and paperboard in 1988, 5% more than the previous year. World pulp production has also followed the same six-year record-breaking path. Output was 160,551,000 tons in 1988, a rise of nearly 4%. Pulp provided about 70% of the papermaking furnish, the lowest proportion since 1983, when it was 75%; in fact, it has been declining by about one percentage point each year—the effect of increasing use of secondary fibers and fillers.

Apparent consumption of paper and board totaled 224,056,000 tons in 1988, up by 4.5% from 1987 and continuing its record run. The world's per capita consumption increased marginally to 43.8 kg (93.4 lb), up from 43 kg (94.6 lb) in 1987 and the highest level in the last 20 years.

The level of trade stayed about the same; a little more than one ton of paper in every five crosses a frontier. For pulp, about 17% of output was traded internationally. The world's export and import figures almost balanced. There were gaps of just 2.3 million tons for paper and board and 1.2 million tons for pulp.

Production records shattered. Europe, North America, and Asia all set new production records. And as they make 94% of the world's paper and board, they are the real record busters. Europe's total of 75.2 million tons was up nearly 5% from 1987. New records were set by Fed. Rep. Germany, which crossed the 10-million-ton mark, and Italy, which made more than 5 million tons for the first time. Other firsts included France, which made more than 6 million tons, and Sweden, which made more than 8 million tons. The three Nordic nations together made 18.5 million tons of paper and board, an incredible 25% of the continent's total, and they exported 14.9 million tons of the stuff.

Asia crashed through the 50-million-ton barrier in 1988. Asia and Australasia's 29 papermakers made 52 million tons, up a staggering 15%. Japan made almost half of this total, raising its output by 2 million tons in just one year—though it saw imports rise, too. People's Rep. China, Rep. Korea, and Taiwan all reached new record levels. These four nations made 84% of the continent's total, but special mention should be made of Indonesia, where output is growing fast—close to 1 million tons in 1988.

The U.S. secured the world's record for output by making 69 million tons of paper, up nearly 3% and backed by record exports and earnings. Prospects for 1989 are fair, but the rate of growth in consumption will probably be slower. Canada's mills ran almost flat out for the second year in a row, making more paper than ever before and exporting nearly 70% of it, as well as shipping 7.2 million tons of market pulp abroad.

Not so hot. The two regions that, in terms of output, did not put in the strongest performances were South America and Africa. The former made slightly more paper and board in 1988 than it did in 1987. This was largely because output in Brazil and Argentina dropped, while in Mexico and Chile it was almost static. The continent's pulp mills performed better, raising output by 4% to top 7 million tons.

Africa's papermakers, with the exception of South Africa, which wants to keep its output secret, are still having difficulty raising output. Once again, many of Africa's figures must be estimated, but the total 2.48 million tons of paper output effectively means it is about the same as it was in 1986. One nation worth mentioning is Zimbabwe, which is working hard to develop its paper industry.

Production figures are a reflection of the market, and there is no doubt that the world's market overall was good once again in 1988. But unmistakable signs of a slowdown in the rate of growth in demand appeared in several major sectors as 1988 progressed. These signs have become stronger in 1989 and lead to the conclusion that the papermakers' party may be coming to an end.

These signs come mostly from the sharp end—the market: the six-month struggle to raise newsprint and kraft liner prices in the U.S., the stickiness of these same sectors in Europe, the leap in newsprint production capacity coming onstream in Europe and America, the gloomier reports from several sectors of Europe's massive printing/writing market, the increasing self-sufficiency of Asian countries (good for them, but not for importers), and the general drop in the rate of demand growth in several major countries.

These and other signs indicate a climb-down from the euphoric heights of recent years, but they may not mean a deep depression; 1989 could still be the seventh year in a row of record production. The party may be over, but hopefully it is back to normality with a slight headache, rather than sinking into a deep sleep.

AFRICA

Paper and board output by African nations is estimated at 2.5 million tons in 1988, roughly the same as in 1987. Pulp production was also a static 2.5 million tons.

South Africa is the colossus of Africa's paper industry. Unfortunately, the country no longer publishes its pulp and paper output statistics, but we estimate that it accounts for two-thirds of all the paper that is produced in Africa as well as three-quarters of all the pulp produced. In addition, South Africa also consumes approximately 40% of all the paper and board used by the continent.

Despite its political isolation, South Africa continues to be a potent force in world export markets. Its paper industry benefits from several key advantages, among which are its fairly high per capita consumption (by African standards); its raw materials resource base; its good geographical position, which makes exporting to the Pacific Rim and elsewhere comparatively easy; and its simple industry structure, which has two giant companies—Sappi Ltd. and Mondi Paper Co. Ltd.—dominating most of the pulp and paper production in the country.

Further rationalization of that industry structure is now under way, with Sappi agreeing to take over the pulp interests of U.K. group Courtaulds. These interests include a 75% share of the massive 450,000-tpy Saiccor Ltd. dissolving pulp mill plus a 50% holding in the highly successful Usutu Pulp Co. in the neighboring country of Swaziland, which has a capacity of 180,000 tpy of unbleached kraft pulp. The latter deal is awaiting approval from the King of Swaziland. The agreement with Courtaulds reinforces Sappi's position as the biggest pulp and paper producer in South Africa. On completion, its capacity will amount to 1.5 million tpy of pulp and 840,000 tpy of paper and board. It will also be one of the leading suppliers in the world of unbleached pulp grades.

WORLD'S TOP 20 PRODUCING AND CONSUMING COUNTRIES, 1988

PAPER AND BOARD PRODUCTION (000 metric tons)			PULP PRODUCTION (000 metric tons)			PER CAPITA CONSUMPTION (lb/year)		
Country	1988	% change 1988/87	Country	1988	% change 1988/87	Country	1988	% change 1988/87
1. U.S.	69,477	2.9%	1. U.S.	55,530	2.8%	1. U.S.	699	9.2%
2. Japan	24,624	9.3	2. Canada	23,679	2.9	2. Sweden	685	30.7
3. Canada	16,638	3.7	3. Japan	10,415	7.0	3. Canada	543	15.8
4. People's Rep. China	12,645	10.8	4. Sweden	10,307	3.3	4. Switzerland	459	10.3
5. U.S.S.R.	10,750	1.7	5. U.S.S.R.	10,065	0.9	5. Japan	450	18.1
6. Fed. Rep. Germany	10,576	6.4	6. Finland	9,001	6.4	6. Finland	449	1.1
7. Finland	8,653	8.0	7. People's Rep. China	8,350	12.8	7. Fed. Rep. Germany	448	10.1
8. Sweden	8,161	4.2	8. Brazil	4,296	3.8	8. Denmark	444	10.2
9. France	6,313	8.2	9. Fed. Rep. Germany	2,358	4.4	9. Belgium	430	15.0
10. Italy	5,370	7.7	10. France	2,190	4.7	10. Netherlands	428	-12.3
11. Brazil	4,639	-1.5	11. Norway	1,917	1.5	11. U.K.	360	15.4
12. U.K.	4,295	2.7	12. South Africa	1,885	2.4	12. New Zealand	345	2.0
13. Rep. Korea	3,659	15.7	13. Spain	1,665	4.2	13. Australia	342	8.6
14. Spain	3,429	5.4	14. Portugal	1,472	4.5	14. Taiwan	337	18.7
15. Taiwan	2,949	7.7	15. Austria	1,455	9.2	15. Norway	333	6.7
16. Austria	2,650	12.4	16. New Zealand	1,212	9.4	16. Hong Kong	323	-0.9
17. Mexico	2,593	0.7	17. Czechoslovakia	1,121	2.8	17. Austria	318	14.0
18. Netherlands	2,462	13.6	18. Australia	1,051	9.0	18. France	313	13.8
19. India	1,915	1.5	19. India	1,050	0.0	19. Italy	238	15.0
20. Australia	1,854	10.5	20. Poland	921	1.7	20. Iceland	230	-5.7

Source: *Pulp & Paper International.*

REVIEW OF TOP 20 NATIONS IN PULP/PAPER PRODUCTION

Australia

Population: 16,358,000. Per capita consumption of paper and board: 113 kg/249 lb. Paper and board mills: 18. Pulp mills: 19 (sulfate: 2; sulfite: 1; semichemical: 5; mechanical: 8; nonwood: 1).

Paper/board capacity: 2,050,000e tons **Pulp capacity:** 1,100,000e tons
Operating rate 1988: 90 %

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	1,233	1,265	513	—	10	—
Board	445	589	—	—	—	—
Total	**1,678**	**1,854**	**800e**	**800e**	**105e**	**110e**
Chemical woodpulp	585	464	279	280e	70	70e
Mechanicals, other pulps	379	588	1	0	0	0
Total	**964**	**1,051**	**280**	**280e**	**70**	**70e**

Austria

Population: 7,493,000. Per capita consumption of paper and board: 143 kg/315 lb. Paper and board mills: 33. Pulp mills: 14 (sulfate: 3; sulfite: 6; semichemical: 1; mechanical: 4).

Paper/board capacity: 3,001,000 tons **Pulp capacity:** 1,085,000 tons
Operating rate 1988: 88 % **Operating rate 1988:** 86 %

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	1,989	2,259	338	347	1,449	1,692
Board	368	391	24	70	269	292
Total	**2,357**	**2,650**	**362**	**417**	**1,718**	**1,984**
Chemical woodpulp	1,014	1,045	339	324	281	260
Mechanicals, other pulps	319	410	18	24	1	2
Total	**1,333**	**1,455**	**357**	**348**	**282**	**262**
Market pulp	363	363	357	348	282	262

Brazil

Population: 144;427,000. Per capita consumption of paper and board: 26 kg/57 lb. Paper and board mills: 146. Pulp mills: 38.

Paper/board capacity: 16 tons **Pulp capacity:** 3 tons
Operating rate 1988: 6 % **Operating rate 1988:** 4 %

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper		5,446,000	3,523,000	85	95	4,188
Board	4,205	265	188	593	956	524
Total	**434**	**3**	**3**	**16**	**49**	**4,712**
Chemical woodpulp	4,639	268	191	609	1,005	3,591
Mechanicals, other pulps	3,709	44	55	807	1,053	546
Total	**587**	**1**	**3**	**9**	**11**	**4,137**
Market pulp	4,296	45	58	816	1,064	1,854

1,85245588161,064

Canada

Population: 26,093,000. Per capita consumption of paper and board: 236 kg/520 lb. Paper and board mills: 109. Pulp mills: 36.

Paper/board capacity: 17,028 tons **Pulp capacity:** 25,021 tons
Operating rate 1988: 98 % **Operating rate 1988:** 95 %

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	15,303	15,915	529	627	11,073	11,352
Board	742	723	229	324	80	68
Total	**16,045**	**16,638**	**700**	**951**	**11,153**	**11,420**
Chemical woodpulp	12,957	13,013	160	156	7,466	7,486
Mechanicals, other pulps	10,056	10,666	38	24	769	903
Total	**23,013**	**23,679**	**198**	**180**	**8,235**	**8,389**
Market pulp	8,011	8,227	NA	NA	7,090	7,210

China, People's Rep. of

Population: 1,096,140,000. Per capita consumption of paper and board: 12 kg/27 lb. Paper and board mills: 5,000e. Pulp mills: 9,000.

Paper/board capacity: 13,000,000 tons **Pulp capacity:** 9,000,000e tons

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Newsprint	365	334	142	102	20	7
Packaging paper/board	5,236e	5,720e	1,101	651	110	155
Other paper/board	5,810e	6,591e	93	99	190	106
Total	**11,411e**	**12,645e**	**1,336**	**852**	**320**	**268**
Chemical woodpulp	1,109	1,198	657	746	5	8
Mechanicals, other pulps	5,381e	6,214e	26	49	0	6
Reed and bagasse	910	938	—	—	—	—
Total	**7,400e**	**8,350e**	**683**	**795**	**5**	**14**

Finland

Population: 4,947,000. Per capita consumption of paper and board: 204 kg/449 lb. Paper and board mills: 46. Pulp mills: 47 (sulfate: 18; sulfite: 3; semichemical: 3; mechanical: 23).

Paper/board capacity: 9,095,000 tons **Pulp capacity:** 9,545,000 tons
Operating rate 1988: 95 % **Operating rate 1988:** 94 %

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	6,913	7,411	64	74	5,837	6,170
Board	1,099	1,242	21	30	900	1,015
Total	**8,012**	**8,653**	**85**	**104**	**6,737**	**7,185**
Chemical woodpulp	5,271	5,610	52	27	1,478	1,491
Mechanicals, other pulps	3,190	3,391	40	46	163	190
Total	**8,461**	**9,001**	**92**	**73**	**1,641**	**1,681**
Market pulp	2,027	2,108	92	73	1,641	1,681

France

Population: 55,789,000. Per capita consumption of paper and board: 142 kg/313 lb. Paper and board mills: 146. Pulp mills: 21 (sulfate: 7; sulfite: 2; semichemical: 1; mechanical: 10; nonwood: 1).

Paper/board capacity: 6,550,000 tons **Pulp capacity:** 2,475,000 tons
Operating rate 1988: 96.4 % **Operating rate 1988:** 88.5 %

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	5,277	5,707	2,406	2,921	1,454	1,676
Board	555	606	633	570	155	194
Total	**5,832**	**6,313**	**3,039**	**3,491**	**1,609**	**1,870**
Chemical woodpulp	2,561	1,655	1,633	1,689	398	405
Mechanicals, other pulps	469	535	132	56	6	0
Total	**2,092**	**2,190**	**1,765**	**1,745**	**404**	**405**
Market pulp	718	754	1,765	1,745	404	405

Germany, Fed. Rep.

Population: 60,714,000. Per capita consumption of paper and board: 201 kg/442 lb. Paper and board mills: 174. Pulp mills: 35 (sulfite: 8; semichemical: 1; mechanical: 24).

Paper/board capacity: 11,397,000 tons **Pulp capacity:** 2,414,000 tons
Operating rate 1988: 94 % **Operating rate 1988:** 98 %

	Production		Imports[1]		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	8,962	9,527	—	5,103	—	3,481
Board	975	1,049	—	468	—	299
Total	**9,937**	**10,576**	**5,134**	**5,571**	**3,384**	**3,780**

1. Because Fed. Rep. Germany has changed to the Harmonized System, comparison of imports/exports 1987 levels is not possible.

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Chemical woodpulp	826	850	3,134	3,235	140	190
Mechanicals, other pulps	1,433	1,508	66	98	—	12
Total	**2,259**	**2,358**	**3,200**	**3,333**	**140**	**202**
Market pulp	282	279	3,200	3,333	140	202

Mondi has also started on a major investment program. In 1989, it rebuilt No. 6 cartonboard paper machine at its Springs mill near Johannesburg, doubling capacity to 81,000 tpy and allowing for further expansion at a later stage. In addition, it plans to raise paper capacity at its different mills by a total of 130,000 tpy. Half of the investment of $160 million will go toward the Merebank mill in Durban, where supercalendered paper output will be raised by 45% to 127,000 tpy through a rebuild of No. 1 paper machine. Work will be completed by early 1990. Capacity at the Richards Bay eucalyptus pulp mill will also be boosted to 420,000 tpy.

Elsewhere in Africa, the picture is less encouraging, with rising raw materials costs and shortages of funds for the purchase of spare parts inhibiting industry development. However, some bright spots exist. Zimbabwe's pulp and paper industry ran at full capacity in 1988, and slow and careful expansion of the industry now seems likely. Plans include a new 60,000-tpy kraft pulp line and fine paper machine and expansion at Hunyani Pulp & Paper Industries Ltd., which is the nation's biggest papermaker. Tanzania's industry, although not operating at anything close to capacity, has begun exporting printing/writing and casemaking materials.

Morocco also continues to shine, with Cellulose du Maroc's 100,000-tpy eucalyptus pulp mill operating at full capacity in 1988 and through first-half 1989. There are long-term prospects that a eucalyptus pulp mill could be built in the Congo. Current expansions are already providing pulpwood to some key European mills.

Overall, however, the outlook is bleak for African producers. Rising interest rates can be expected to restrict further the availability of dollars to import raw materials for pulp and papermaking or to expand output. And domestic consumption levels are also limited by the failing economies of most of the African nations.

ASIA/AUSTRALASIA

Output of paper and board in Asia/Australasia climbed by 9.5% to 52.0 million tons in 1988. It was the first time the continent has broken through the 50-million-ton mark, and it is a milestone in the development of the region's paper industry. Pulp production also rose strongly by 9%, soaring to 30.4 million tons. Again, a magic number—30 million tons—was crossed for the first time.

The year 1988 was a good one for the major producers: Japan, People's Rep. China, Rep. Korea, and Taiwan. But it was also a year in which growing attention was focused on the rising stars of the continent: Indonesia, Thailand, and Turkey. To the south, the Australasian pulp and paper industries of New Zealand and Australia continued a phase of expansion and internationalization.

The leading paper and board producer of the continent is Japan, which is also the world's second-largest producer. In 1988, its paper and board output soared from 1987 levels by 9.3% to 24.6 million tons. Most of the increase was fueled by a booming domestic economy, with GNP racing ahead by 5.7%. Commercial printing and advertising led the way in boosting the markets for paper, especially coated grades.

With the value of the yen continuing high against other currencies, Japanese imports might have been expected to rise sharply. To some extent they did, because imports passed 1 million tons for the first time, rising by 20.6%. Even so, they still account for only 4% of total Japanese consumption. The yen's high value also affected exports, which tumbled by 22% to 636,000 tons.

A new investment wave swept the Japanese industry in 1988 in response to rising profits. Estimates show that $3.464 million was invested in 1988, an increase of 44% from 1987, and that 57% of the investment is designed to increase capacity, mainly in wood-free paper, in all types of coated paper, and in newsprint. A large amount of offshore investment is also taking place, with North America a key target for investment yen and with growing interest in Australasia and Europe. In looking for offshore opportunities, Japanese producers aim to use their burgeoning profits to guarantee their fiber needs for the future and, anticipating a continuing high value for the yen, to supply the country's import requirements for the future.

People's Rep. China continued its relentless climb up the ladder of the world's leading papermakers in 1988, producing more than 12.6 million tons of paper and board, an increase of nearly 11% from 1987. In just two years (1986-88), its output grew by more than 25%, and it is now the fourth-biggest producer in the world. Per capita consumption, however, is a mere 12.1 kg (26 lb), and similar annual growth rates will have to be sustained if the country is to reach its per capita consumption target of 40 kg (88 lb) by the year 2000.

Although it is still too soon to tell, it seems unlikely that the recent political and social unrest in the country will lead to a change in the government's economic policy. A continuing program of modernization of existing pulp and paper lines plus further investment in pulp mills can be expected. Among the most interesting projects now under consideration is a 250,000-tpy, joint-venture softwood pulp mill to be built with the U.S.S.R. in Heilongjiang, China. It would use larch pulpwood from Soviet Siberia.

The third-biggest paper producer of the region, Rep. Korea, had an important year in 1988. It played host to the Summer Olympic Games, recorded yet another year of impressive economic growth (GNP rose by 12.2%), and successfully conducted the first fully democratic parliamentary elections in its history. Against this background, producers of printing/writing paper and newsprint fared particularly well. Newsprint, in particular, was in short supply. Coated duplex board also performed well, but for the linerboard industry it was a different story. Overcapacity and an appreciation of the local currency (the won) against the dollar combined with a fall in demand from Hong Kong and People's Rep. China to dent profitability in this sector. Reductions in the tariffs paid by imports have also damaged this sector of the industry.

Taiwan's paper and board output was up by 7.8% to 2.95 million tons, a figure that is considered disappointing in view of the fast growth of previous years. Reasons for

REVIEW OF TOP 20 NATIONS IN PULP/PAPER PRODUCTION (continued)

India

Population: 818,782,000. Per capita consumption of paper and board: 3e kg/6e lb. Paper and board mills: 300. Pulp mills: 1.

Paper/board capacity: 2,760,000 tons

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	1,136	1,165e	300	300	—	—
Board	750	750e	0	0	—	—
Total	**1,886**	**1,915e**	**300**	**300e**	**—**	**—**
Total pulp	**1,050**	**1,050e**	**300**	**300e**	**—**	**—**
Market pulp	15	30e	300	300e	—	—

Italy

Population: 57,265,000. Per capita consumption of paper and board: 108 kg/238 lb. Paper and board mills: 340. Pulp mills: 21 (sulfite: 2; semichemical: 3; mechanical: 15; nonwood: 1).

Paper/board capacity: 5,800,000 tons **Pulp capacity:** 1,080,000 tons
Operating rate 1988: 93% **Operating rate 1988:** 73%

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	4,033	4,339	1,920	1,941	949	1,033
Board	954	1,031	204	208	214	276
Total	**4,987**	**5,370**	**2,124**	**2,149**	**1,163**	**1,309**
Chemical woodpulp	218	230	1,938	2,017	36	48
Mechanicals, other pulps	519	559	147	130	8	8
Total	**737**	**789**	**2,085**	**2,147**	**44**	**56**
Market pulp	250	270	2,085	2,147	44	56

Japan

Population: 122,424,000. Per capita consumption of paper and board: 204 kg/449 lb. Paper and board mills: 489. Pulp mills: 60 (sulfate: 37; sulfite: 4; semichemical: 8; mechanical: 27; nonwood: 3).

Paper/board capacity: 27,143,000 tons **Pulp capacity:** 13,176,000 tons
Operating rate 1988: 90.7% **Operating rate 1988:** 69.6%

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	19,537	21,446	825	914	608	491
Board	3,000	3,178	43	133	206	145
Total	**22,537**	**24,624**	**868**	**1,047**	**814**	**636**
Chemical woodpulp	7,607	8,055	2,031	2,331	16	13
Mechanicals, other pulps	2,126	2,360	700	759	0	0
Total	**9,733**	**10,415**	**2,731**	**3,090**	**16**	**13**
Market pulp	956	917	2,731	3,090	16	13

Korea, Rep. of

Population: 42,621,000. Per capita consumption of paper and board: 82 kg/181 lb. Paper and board mills: 150e. Pulp mills: 5 (sulfate: 1; mechanical: 4).

Paper/board capacity: 4,674,000 tons **Pulp capacity:** 390,000 tons
Operating rate 1988: 89% **Operating rate 1988:** 80%

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	2,507	2,907	150	172	116	139
Board	656	752	6	4	282	212
Total	**3,163**	**3,659**	**156**	**176**	**398**	**351**
Chemical woodpulp	147	155	739	823	0	0
Mechanicals, other pulps	168	158	60	82	0	0
Total	**315**	**313**	**799**	**905**	**0**	**0**
Market pulp	147	155	799	905	0	0

Mexico

Population: 84,884,000. Per capita consumption of paper and board: 30 kg/65 lb. Paper and board mills: 67. Pulp mills: 15 (sulfate: 8; mechanical: 2; nonwood: 5).

Paper/board capacity: 3,375,000 tons **Pulp capacity:** 1,060,000 tons
Operating rate 1988: 77% **Operating rate 1988:** 76%

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	2,229	2,323	61	128	243	252
Board	276	270	5	15	0	1
Total	**2,575**	**2,593**	**66**	**143**	**243**	**253**
Chemical woodpulp	439	433	454	310	20	49
Bleached bagasse/straw	227	247	0	0	0	0
Mechanicals, other pulps	134	129	25	43	0	4
Total	**800**	**809**	**479**	**353**	**20**	**53**

Netherlands

Population: 14,758,000. Per capita consumption of paper and board: 195 kg/428 lb. Paper and board mills: 32. Pulp mills: 3 (mechanical: 2, nonwood: 1).

Paper/board capacity: 2,575,000 tons **Pulp capacity:** 198,000 tons
Operating rate 1988: 96% **Operating rate 1988:** 93%

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	1,495	1,720	1,580	1,695	1,028	1,221
Board	673	742	338	399	411	462
Total	**2,168**	**2,462**	**1,918**	**2,094**	**1,439**	**1,683**
Chemical woodpulp	0	0	561	598	31	22
Mechanicals, other pulps	135	184	26	23	3	4
Total	**135**	**184**	**587**	**621**	**34**	**26**

Spain

Population: 39,053,000. Per capita consumption of paper and board: 99 kg/217 lb. Paper and board mills: 161. Pulp mills: 26 (sulfate: 24; sulfite: 1; mechanical: 5; nonwood: 3).

Paper/board capacity: 3,650,000 tons **Pulp capacity:** 174,000 tons
Operating rate 1988: 95% **Operating rate 1988:** 96%

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	2,895	3,060	689	913	358	367
Board	357	369	54	14	103	71
Total	**3,252**	**3,429**	**743**	**927**	**461**	**438**
Chemical woodpulp	1,379	1,445	420	410	505	536
Mechanicals, other pulps	219	220	9	12	7	11
Total	**1,598**	**1,665**	**429**	**422**	**512**	**547**
Market pulp	803	801	429	422	512	547

Sweden

Population: 8,346,000. Per capita consumption of paper and board: 242 kg/532 lb. Paper and board mills: 55. Pulp mills: 55 (sulfate: 25; sulfite: 7; semichemical: 2; mechanical: 21).

Paper/board capacity: 8,630,000 tons **Pulp capacity:** 10,870,000 tons
Operating rate 1988: 95% **Operating rate 1988:** 95%

	Production		**Imports**		**Exports**	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	6,584	6,882	203	196	5,084	5,356
Board	1,250	1,279	85	79	1,012	1,021
Total	**7,834**	**8,161**	**288**	**275**	**6,096**	**6,377**
Chemical woodpulp	7,001	7,155	119	103	2,416	2,463
Mechanicals, other pulps	2,972	3,152	25	32	619	728
Total	**9,973**	**10,307**	**144**	**135**	**3,035**	**3,191**
Market pulp	3,526	3,662	144	135	3,035	3,191

REVIEW OF TOP 20 NATIONS (continued)

Taiwan

Population: 19,900,000. Per capita consumption of paper and board: 149 kg/327 lb. Paper and board mills: 152. Pulp mills: 3 (sulfate: 2; nonwood: 1).

Paper/board capacity: 3,250,000e tons **Pulp capacity:** 500,000e tons

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	2,091	2,282	276	335	67	146
Board	646	667	12	8	78	101
Total	**2,737**	**2,949**	**288**	**343**	**145**	**247**
Chemical woodpulp	331	350	335	367	65	86
Bleached bagasse	73	73	0	—	16	14
Mechanical, other pulps	12	2	44	74	1	1
Total	**416**	**425**	**379**	**441**	**82**	**101**

United Kingdom

Population: 56,799,000. Per capita consumption of paper and board: 163 kg/360 lb. Paper and board mills: 92. Pulp mills: 7 (semichemical: 2; mechanical: 3; nonwood: 2).

Paper/board capacity: 4,676,000 tons **Pulp capacity:** 466,000 tons
Operating rate 1988: 96% **Operating rate 1988:** 95%

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	3,337	3,410	4,396	4,965	458	608
Board	846	885	887	823	274	190
Total	**4,183**	**4,295**	**5,283**	**5,788**	**732**	**798**
Chemical woodpulp	NA	NA	1,737	1,851	1	1
Mechanicals, other pulps	NA	NA	203	237	3	7
Total	**389**	**421**	**1,940**	**2,088**	**4**	**8**

United States

Population: 245,414,000. Per capita consumption of paper and board: 317 kg/69 lb. Paper and board mills: 548. Pulp mills: 217 (sulfate: 125; sulfite: 17; semichemical: 36; mechanical: 39).

Paper/board capacity: 72,862,000 tons **Pulp capacity:** 56,860,000 tons
Operating rate 1988: 95.4% **Operating rate 1988:** 97.7%

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	56,546	58,264	10,864	11,109	2,978	3,355
Board	10,988	11,213	137	102	1,079	939
Total	**67,534**	**69,477**	**11,001**	**11,211**	**4,057**	**4,294**
Chemical woodpulp	47,663	48,899	4,137	4,010	3,749	4,212
Mechanicals, other pulps	6,363	6,631	263	561	687	803
Total	**54,026**	**55,530**	**4,400**	**4,571**	**4,436**	**5,015**
Market pulp	7,361	7,770	2,935	3,149	4,373	4,600

U.S.S.R.

Population: 283,682,000. Per capita consumption of paper and board: 38 kg/83 lb. Paper and board mills: 173. Pulp mills: 54 (sulfate: 21; sulfite: 34; semichemical: 7).

Paper/board capacity: 11,494,000 tons **Pulp capacity:** 9,244,000 tons
Operating rate 1988: 94e%

	Production		Imports		Exports	
	1987	**1988**	**1987**	**1988**	**1987**	**1988**
Paper	9,348	9,500e	225	235e	906	905e
Board	1,218	1,250e	—	—	—	—
Total	**10,566**	**10,750e**	**555**	**575e**	**1,252**	**1,300e**
Chemical woodpulp	7,180	7,225e	222	221e	1,088	1,096e
Mechanicals, other pulps	2,794	2,840e	3	4e	—	—
Total	**9,974**	**10,065e**	**225**	**225e**	**1,088**	**1,100e**
Market pulp	3,212	3,250e	225	225e	1,088	1,100e

the slowdown were (as with Rep. Korea) some overcapacity, appreciation of the local currency against the dollar, liberalization of trade, and an increase in imports. Without these factors, output would have crossed the 3-million-ton mark in 1988. A redeeming factor, however, was that exports rose to almost 250,000 tons.

Turning to the rising stars of the East, Indonesia's paper and board output rose in 1988 by 12.7% to 932,000 tons, and the million-ton mark should be crossed in 1989. With its good growing conditions for pulpwood, reserves of mixed tropical hardwood, and favorable location in the Far East market, Indonesia is coming under scrutiny as an investment prospect for the world's pulp- and papermakers. Scott Paper Co. is among those considering new pulp mills, and predictions are that about 1 million tons of new pulp capacity could start up by the end of the century. In 1988, a new 7.1-m-wide kraft paper and kraft liner machine was started up by domestic producer Kertas Kraft Aceh. It is designed to replace imports in the short term, but some export tonnage will be available in the future.

Also approaching 1 million tons of annual paper and board output is Turkey. Its output was cut to 715,000 tons by labor disputes in 1988, but potentially it could approach 850,000 tons in 1989. Several companies view Turkey as a prospect for expansion because of its low per capita consumption of 15 kg (33 lb) and because of its geographic position amid Europe, the Middle East, and Asia.

Thailand is also becoming an attractive site for investment, and many reports are circulating of major pulp mill projects to be based on pulpwood plantations. Interest in the Philippines is also growing, with the largest company there, state-owned Picop, up for sale.

In Australasia, output of paper and board rose by 10% to nearly 2.6 million tons in 1988. There was continuing rationalization in New Zealand, with Australian brewing company Elders Resources winning control of New Zealand Forest Products Ltd. and subsequently announcing a major expansion of the Kinleith kraft liner and market pulp mill in New Zealand. Another New Zealand company, Carter Holt Harvey (CHH) acquired the country's major tissue producer, Caxton Paper Mills Ltd. CHH has also been active overseas in recent years, acquiring a share in Chilean-market pulp producer Celulosa Arauco y Constitucion. New Zealand's largest company, Fletcher Challenge Ltd., also looked to Latin America in 1988, buying control of Brazilian newsprint producer Pisa. In Canada, Fletcher merged its Crown Forest Industries Ltd. and British Columbia Forest Products Ltd. subsidiaries under the name Fletcher Challenge Canada. In Australia, it acquired 50% of Australian Newsprint Mills Ltd. At its subsidiary, Tasman Pulp & Paper Co. Ltd. in New Zealand, Fletcher is currently increasing pulp capacity by 30,000 tpy and modernizing its three paper machines, adding an extra 45,000 tpy of newsprint.

Australia witnessed an influx of interest from foreign companies in 1988-89. APM devised a plan with Noranda Forest Inc. of Canada for a 400,000-tpy pulp mill to be built in Wesley Vale, Tasmania. However, Noranda subsequently withdrew in the face of unacceptable and loosely worded environmental restrictions. Daishowa Paper Manufacturing Co. Ltd. of Japan has now resurrected that project, planning perhaps to make unbleached pulp in Tasmania and to export the product for bleaching to Japan. Daishowa is also planning a $365-million mill for Australia. It would make 150,000 tpy of kraft liner for the Australian market and 150,000 tpy of eucalyptus market pulp. Australia's Amcor, meanwhile, is seeking acquisitions in the paper and packaging sector, with the U.S. and Europe as the main target areas for expansion.

The Indian subcontinent is still the weak point in the Asian pulp- and papermaking world. With poor power and fiber supply and the absence of financial resources, India, Pakistan, and Bangladesh are not easily able to boost their output. Efforts are being concentrated on newsprint and printing papers, and in the case of India, some substantial progress has been made in the production of newsprint from a bagasse furnish.

EUROPE

Total paper and board output in Europe rose 5.6% to 75.2 million tons in 1988. Western Europe, including the Nordic countries, recorded a rise in output of 6.8% to 57.4 million tons. Eastern Europe turned in a relatively static performance, with output up by an estimated 1.8% to 17.9 million tons. Apparent consumption for the whole continent also set a new record of 71 million tons, up 5.5%, and apparent per capita consumption was 91.2 kg (200.6 lb). Again, there was a disparity between West and East. For the western nations, per capita consumption averaged 152 kg (334.4 lb); for the eastern countries, it was slightly below the world average at an estimated 40 kg (88 lb).

Production of pulp in Europe also reached a new record level, rising 3.9% to 47.3 million tons. Some 32.7 million tons of the total were produced in Western Europe. Apparent pulp consumption was 50.7 million tons for the whole continent, another record.

The nations of the European Community (EC) had an exceptional year in terms of both output and investment. Advertising and commercial print boomed, pushing up demand for printing paper, while strong growth (economic overheating in some countries) kept the packaging sector buoyant.

The EC's biggest producer, Fed. Rep. Germany, again set new highs for paper and board production and consumption. Its output of all grades passed 10 million tons for the first time, rising 6% to 10.6 million tons. Some 42% of the output is printing grades, while packaging grades account for 37%. France's paper producers put in an impressive performance, with output rising from 1987 levels by 8.2% to 6.3 million tons. Consumption rose even faster, up 9.2%. Italy also set records, with output crossing 5 million tons for the first time. The U.K.'s output climbed steadily by 2.7% to 4.3 million tons.

Many paper producers feel that the removal of internal barriers to trade within the EC at the end of 1992 will make little difference to their business activity. They argue that pulp and paper are already internationally traded commodities; the removal of borders will merely simplify customs controls. But many expect deregulation of the transport systems in Europe, which should cut costs, and more central regulation of political issues, such as the environment. Changes will also probably occur in distribution patterns.

Producers from outside the EC, however, have fears of being excluded when European borders are removed. A boom in investment has taken place in the EC during the past two years, with Nordic and North American companies arriving in strength. It would be wrong, though, to say that all of this investment is driven by the opening of borders in 1992. Rather, it is a response to the formation of a single market of 320 million people, to the competitive advantages of making commodity paper grades closer to their consumers, and to the comparatively low per capita consumption of some (mainly southern) EC countries.

For the Nordic nations of Sweden, Norway, and Finland, 1988 was another year of full capacity utilization. Finnish output of paper and board, having crossed 8 million tons for the first time in 1987, passed 8.5 million tons in 1988. Sweden rose above 8 million tons for the first time. Norway maintained its full capacity output level of around 1.6 million tons. Over the past six record years, the Nordic industry has slimmed down into internationally powerful papermaking groups. A reassessment of investment policy, with more high-value-added products in the Nordic countries and more bulk-grade production moved closer to the consumer markets, has been one result.

In Eastern Europe, after years of stagnation, there are moves to revitalize the pulp and paper industry. Nowhere is this more apparent than in the U.S.S.R. Although it is the fifth-largest paper producer in the world, the U.S.S.R. has a per capita consumption below the world average. New plans formulated by the ministry responsible for the pulp and paper industry have set a target of doubling per capita consumption by 1995. The plans foresee major investment and an opening up of the Soviet industry to foreign capital. Investors from outside the U.S.S.R. may participate in joint-venture projects, especially in the newsprint, printing paper, and market pulp sectors. Depending on circumstances, they will be allowed to hold a majority share of the joint ventures formed, to set market prices, and to repatriate funds to their shareholders abroad.

Already, there are takers. Finnish company Metsä-Serla is building a joint-venture tissue mill in Estonia, and companies in Austria, Canada, Italy, and Fed. Rep. Germany are believed to be involved in talks with Soviet authorities.

If the plans advance rapidly, several foreign companies may find the U.S.S.R. an attractive place to invest. Its large population, low per capita consumption, and big forest reserves could well justify the investment. And if the U.S.S.R. sets a course of letting in foreign capital, most other eastern European nations may well follow.

LATIN AMERICA

The performance of the Latin American paper and board industries was disappointing in 1988. In the face of weak domestic markets, output of paper and board crawled ahead

World pulp, paper, and board industry at a glance

Country	Population (1,000)	Number of mills P&B	Number of mills Pulp	Capacity (1,000 tons) P&B	Capacity (1,000 tons) Pulp	Per capita (lb)	Apparent consumption (1,000 tons) P&B 1987	Apparent consumption P&B 1988	Apparent consumption Pulp 1987	Apparent consumption Pulp 1988	Production (1,000 tons) P&B 1987	Production P&B 1988	Production Pulp 1987	Production Pulp 1988
EUROPE														
Belgium	9,925	14	3	1,190	450	430	1,863	1,938	717	770	1,030	1,134	389	448
Denmark	5,119	6	3	344	102	444	982	1,034	135	133	323	343	81	95
France	55,789	146	21	6,550	2,475	313	7,262	7,934	3,453	3,530	5,832	6,313	2,092	2,190
Germany, Fed. Rep.	60,714	174	35	11,397	2,414	448	11,687	12,367	5,319	5,489	9,937	10,576	2,259	2,358
Greece	10,013	25	2	500	75	143	680	650	230	255	416	375	50	65
Ireland	3,650	1	0	40	0	186	305	309	0	0	30	34	0	0
Italy	57,265	340	21	5,800	1,080	238	5,948	6,210	2,778	2,880	4,987	5,370	737	789
Netherlands	14,758	32	3	2,575	198	428	2,647	2,873	688	779	2,168	2,462	135	184
Portugal	10,246	90	8	833	1,453	143	602	664	398	420	627	681	1,408	1,472
Spain	39,053	161	33	3,650	174	221	3,534	3,918	1,515	1,540	3,252	3,429	1,598	1,665
United Kingdom	56,799	92	7	4,676	466	360	8,734	9,285	2,325	2,501	4,183	4,295	389	421
EEC	**323,331**	**1,081**	**136**	**37,555**	**8,887**	**321**	**44,244**	**47,182**	**17,558**	**18,297**	**32,785**	**35,012**	**9.138**	**9,687**
Finland	4,947	46	47	9,095	9,545	699	1,360	1,572	6,912	7,393	8,012	8,653	8,461	9,001
Norway	4,200	19	23	1,900	2,150	333	569	635	1,382	1,359	1,590	1,670	1,889	1,917
Sweden	8,346	55	55	8,630	10,870	543	2,026	2,059	7,082	7,251	7,834	8,161	9,973	10,307
Nordic	**17,493**	**120**	**125**	**19,625**	**22,565**	**537**	**3,955**	**4,266**	**15,376**	**16,003**	**17,436**	**18,484**	**20,323**	**21,225**
Austria	7,493	33	14	3,001	1,686	318	1,001	1,083	1,408	1,541	2,357	2,650	1,333	1,455
Iceland	249	0	0	0	0	230	27	26	0	0	0	0	0	0
Malta	347	0	0	0	0	63	10	10	0	0	0	0	0	0
Switzerland	6,567	29	6	1,250	365	459	1,327	1,370	596	634	1,147	1,216	324	335
Other W. Europe	**14,656**	**62**	**20**	**4,251**	**2,051**	**374**	**2,365**	**2,489**	**2,004**	**2,175**	**3,504**	**3,866**	**1,657**	**1,790**
Total W. Europe	**355,480**	**1,263**	**281**	**61,431**	**33,503**	**334**	**50,564**	**53,937**	**34,938**	**36,475**	**53,725**	**57,362**	**31,118**	**32,702**
Albania	3,134	4	4	15e	15e	11	17	15	10	10	10	10	10	10
Bulgaria	8,995	15	9	520e	260e	108	440	440	271	270	350	350	220	220
Czechoslovakia	15,624	36	23	1,261	1,223	172	1,181	1,220	890	918	1,261	1,259	1,090	1,121
German Dem. Rep	16,661	21	19	1,500e	750e	184	1,356	1,395	835	835	1,339	1,362	672	690
Hungary	10,600	10	4	550e	150e	143	668	688	272	292	522	535	69	81
Poland	37,960	47	20	1,560	1,057	83	1,391	1,431	1,090	1,110	1,375	1,444	906	921
Romania	23,048	20e	12e	850e	750e	70	728	730	660	660	768	770	610	610
USSR	283,682	173	54	11,494	11,000e	78	9,869	10,025	9,111	9,185	10,566	10,750	9,974	10,065
Yugoslavia	23,569	30	21	1,500	900	106	1,086	1,133	879	943	1,343	1,377	800	837
E. Europe	**423,273**	**356**	**166**	**19,250**	**16,105**	**89**	**16,736**	**17,077**	**14,018**	**14,223**	**17,534**	**17,857**	**14,351**	**14,555**
Total Europe	**778,753**	**1,619**	**447**	**80,681**	**49,608**	**201**	**67,300**	**71,014**	**48,956**	**50,698**	**71,259**	**75,219**	**45,469**	**47,257**
NORTH AMERICA														
Canada	26,093	109	36	17,028	25,021	520	5,592	6,169	14,976	15,470	16,045	16,638	23,013	23,679
United States	245,414	548	217	72,862	56,860	685	74,478	76,394	53,990	55,086	67,534	69,477	54,026	55,530
North America	**271,507**	**657**	**253**	**89,890**	**81,881**	**669**	**80,070**	**82,563**	**68,966**	**70,556**	**83,579**	**86,115**	**77,039**	**79,209**
ASIA														
Afghanistan	15,090	0	0	0	0	<1	2	3	0	0	0	0	0	0
Bahrain	481	0	0	0	0	28	6	6	0	0	0	0	0	0
Bangladesh	109,579	8	9	127	126	2	117	125	99	99	115	122	83	76
Bhutan	1,451	0	0	0	0	2	1	1	0	0	0	0	0	0
Brunei	249	0	0	0	0	26	3	3	0	0	0	0	0	0
Burma	39,966	3	2	31	30	3	47	47	27	27	27	27	29	29
China, Peo. Rep.[1]	1,096,140	200	50e	13,000e	9,000e	27	12,427	13,229	8,078	9,131	11,411	12,645	7,400	8,350
Cyprus	687	1	0	10e	0	119	37	37	1	1	2	2	0	0
Hong Kong	5,692	2	0	85e	0	323	810	837	0	0	10	17	0	0
India	818,782	300	100e	2,760	1,450e	5	2,075	1,915	1,350	1,350	1,886	1,915	1,050	1,050
Indonesia	174,951	40	17e	1,162	747	10	783	829	575	658	827	932	350	467
Iran	53,126	6	2	315	188	18	422	426	75	77	105	142	60	65
Iraq	17,656	0	0	0	0	9	65	68	39	76	25	28	14	18
Israel	4,442	5	0	186	0	228	414	461	66	67	164	179	0	0
Japan	122,424	489	60	27,143	13,176	450	22,591	25,035	12,448	13,492	22,537	24,624	9,733	10,415
Jordan	3,943	3	0	180	0	37	67	67	5	4	14	10	0	0
Kampuchea	7,869	0	0	0	0	1	2	2	0	0	0	0	0	0
Korea, Peo. Rep	21,902	0	0	0	0	8	80	80	70	70	80	80	60	60
Korea, Rep. of	42,621	150e	5	4,674	390	180	2,921	3,484	1,114	1,218	3,163	3,659	315	313
Kuwait	1,938	1	0	25	0	103	91	91	10	10	23	23	0	0
Laos	3,874	0	0	0	0	1	1	1	0	0	0	0	0	0
Lebanon	2,827	3	0	50e	0	35	75	45	5	5	15	15	0	0
Macao	443	0	0	0	0	20	4	4	0	0	0	0	0	0
Malaysia	16,573	14	1	220	92	73	502	547	27	27	82	204	0	0
Mongolia	2,092	1	1	10e	6e	21	20	20	5	5	5	5	5	5
Nepal	18,033	2	2	8	8	3	20	21	0	0	4	7	0	0
Oman	1,377	0	0	0	0	10	6	6	0	0	0	0	0	0
Pakistan	114,939	15	3	160e	100e	6	344	288	116	111	98	101	75	70
Philippines	59,456	27	3	506	195	20	509	534	198	163	308	341	146	113
Qatar	340	0	0	0	0	65	10	10	0	0	0	0	0	0
Saudi Arabia	13,070	0	0	0	0	17	100	100	0	0	0	0	0	0
Singapore	2,645	2	0	31	0	183	0	220	6	6	0	10	0	0
Sri Lanka	16,779	2	2	27	26	4	27	27	15	15	27	27	6	6
Syria	11,638	13	14	8e	6e	15	80	80	5	5	5	5	5	5
Taiwan	19,900	0	3	3,250e	500e	337	2,880	3,045	713	765	2,737	2,949	416	425
Thailand	54,124	33	5	724	150e	33	825	825	210	230	610	610	150	170
Turkey	53,536	35	14	964	726	34	850	818	540	492	816	715	450	352
United Arab Emirates	1,501	0	0	0	0	110	73	75	0	0	0	0	0	0
Vietnam	64,227	30e	1	120e	60e	2	66	66	55	60	60	60	25	30
Yemen Arab Rep.	7,534	0	0	0	0	1	2	2	0	0	0	0	0	0
Yemen Dem. Rep.	2,339	0	0	0	0	2	2	2	0	0	0	0	0	0
Asia	**3,006,236**	**1,385**	**294**	**55,776**	**26,976**	**39**	**49,357**	**53,482**	**25,852**	**28,164**	**45,156**	**49,454**	**20,372**	**22,019**

1. Peo. Rep. China has an approximate total of 5,000 paper mills and 9,000 pulp mills. Only the largest 250 are included here.

Country	Population (1,000)	Number of mills		Capacity (1,000 tons)		Per capita (lb)	Apparent consumption (1,000 tons)				Production (1,000 tons)			
							P&B		Pulp		P&B		Pulp	
		P&B	Pulp	P&B	Pulp		1987	1988	1987	1988	1987	1988	1987	1988
LATIN AMERICA														
Argentina	31,536	100	25	1,300	880	70	1,140	1,000	708	700	1,064	1,001	725	727
Bahamas	253	0	0	0	0	130	15	15	0	0	0	0	0	0
Barbados	257	0	0	0	0	60	7	7	0	0	0	0	0	0
Belize	174	0	0	0	0	38	3	3	0	0	0	0	0	0
Bolivia	6,918	1	0	2e	0	7	21	21	0	0	1	1	0	0
Brazil	144,427	146	38	5,446	4,523	58	4,371	3,825	3,366	3,290	4,712	4,639	4,137	4,296
Chile	12,748	7	7	423	900e	61	350	352	338	381	442	450	861	910
Colombia	30,566	24	5	563	266	42	573	587	293	290	488	504	247	247
Costa Rica	2,866	2	1	18	25	92	122	120	7	7	12	12	6	6
Cuba	10,154	9	3	155e	60e	70	322	321	105	110	149	150	52	55
Dominican Rep.	6,867	2	0	15e	0	21	65	65	4	4	9	9	0	0
Ecuador	10,203	5	2	65	35	21	97	97	17	17	67	67	6	6
El Salvador	5,026	3	0	50e	0	29	67	67	12	12	29	29	0	0
Guatemala	8,680	4	0	60	0	22	72	86	9	9	34	40	0	0
Guyana	1,006	0	0	0	0	15	7	7	0	0	0	0	0	0
Haiti	6,263	0	0	0	0	2	6	6	0	0	0	0	0	0
Honduras	4,830	0	0	0	0	13	29	29	0	0	0	0	0	0
Jamaica	2,446	1	0	15	0	39	43	43	1	1	13	13	0	0
Mexico	84,884	67	15	3,375	1,060	64	2,398	2,483	1,259	1,109	2,575	2,593	800	809
Neth. Antilles	188	0	0	0	0	35	3	3	0	0	0	0	0	0
Nicaragua	3,622	0	0	0	0	5	8	8	0	0	0	0	0	0
Panama	2,322	3	0	30e	0	79	83	83	1	1	28	28	0	0
Paraguay	4,040	3	0	25e	0	14	26	26	0	0	13	13	0	0
Peru	21,254	17	3	405	270	31	235	303	144	151	148	218	90	92
Surinam	392	0	0	0	0	22	9	4	0	0	0	0	0	0
Trinidad/Tobago	1,243	0	0	0	0	58	48	33	2	2	0	0	0	0
Uruguay	3,081	5	2	83	27	49	64	69	36	33	58	66	27	26
Venezuela	18,756	12	3	785	184	108	811	922	395	372	654	708	101	103
Latin America	**425,002**	**411**	**104**	**12,815**	**8,230**	**55**	**10,995**	**10,585**	**6,697**	**6,489**	**10,496**	**10,541**	**7,052**	**7,277**
AUSTRALASIA														
Australia	16,358	18	19	2,050e	1,100e	342	2,373	2,544	1,174	1,051	1,678	1,854	964	1,051
Fiji	700	0	0	0	0	41	12	13	0	0	0	0	0	0
New Zealand	3,356	6	7	822	1,463	345	533	527	591	653	644	701	1,108	1,212
Papua New Guinea	3,804	0	0	0	0	4	6	6	0	0	0	0	0	0
Samoa	204	0	0	0	0	32	3	3	0	0	0	0	0	0
Australasia	**24,422**	**24**	**26**	**2,872**	**2,563**	**279**	**2,927**	**3,093**	**1,765**	**1,704**	**2,322**	**2,555**	**2,072**	**2,263**
AFRICA														
Algeria	23,841	6	3	160e	170e	17	180	180	95	95	110	110	35	35
Angola	9,481	2	1	30e	45e	4	19	19	15	15	15	15	15	15
Benin	4,448	0	0	0	0	2	4	4	0	0	0	0	0	0
Botswana	1,198	0	0	0	0	2	1	1	0	0	0	0	0	0
Burkina Faso	8,529	0	0	0	0	<1	1	1	0	0	0	0	0	0
Burundi	5,147	0	0	0	0	2	4	4	0	0	0	0	0	0
Cameroon	10,674	0	0	0	0	2	10	10	0	0	0	0	0	0
Central African Rep	2,771	0	0	0	0	1	1	1	0	0	0	0	0	0
Chad	5,401	0	0	0	0	<1	1	1	0	0	0	0	0	0
Congo	1,888	0	0	0	0	1	1	1	0	0	0	0	0	0
Egypt	51,453	16	3	180e	60e	24	550	560	100	100	160	160	70	70
Ethiopia	44,727	1	0	15e	0	1	21	21	4	4	11	11	0	0
Gabon	1,094	0	0	0	0	4	2	2	0	0	0	0	0	0
Gambia	812	0	0	0	0	6	2	2	0	0	0	0	0	0
Ghana	14,130	0	0	0	0	1	9	9	0	0	0	0	0	0
Guinea	6,540	0	0	0	0	1	4	4	0	0	0	0	0	0
Ivory Coast	11,612	0	0	0	0	15	77	80	0	0	0	0	0	0
Kenya	23,100	5	6	103	100	11	119	119	100	100	106	106	96	96
Lesotho	1,676	0	0	0	0	1	1	1	0	0	0	0	0	0
Liberia	2,396	0	0	0	0	1	1	1	0	0	0	0	0	0
Libya	4,232	10	0	10e	0	7	14	14	6	6	6	6	0	0
Madagascar	11,238	2	2	28	6	2	8	8	7	7	8	8	4	4
Malawi	7,884	0	0	0	0	3	12	12	0	0	0	0	0	0
Mali	8,824	0	0	0	0	<1	1	1	0	0	0	0	0	0
Mauritania	1,916	0	0	0	0	5	4	4	0	0	0	0	0	0
Mauritius	1,077	0	0	0	0	12	6	6	0	0	0	0	0	0
Morocco	23,910	7	1	126	100	23	233	251	51	18	115	115	101	108
Mozambique	14,845	2	0	10e	0	2	17	17	1	1	2	2	0	0
Niger	6,688	0	0	0	0	1	3	3	0	0	0	0	0	0
Nigeria	105,471	5	2	170	140	8	403	403	51	52	79	79	39	40
Rwanda	6,755	0	0	0	0	2	5	5	0	0	0	0	0	0
Senegal	6,978	0	0	0	0	1	4	4	0	0	0	0	0	0
Sierra Leone	3,946	0	0	0	0	1	1	1	0	0	0	0	0	0
Somalia	7,106	0	0	0	0	1	2	2	0	0	0	0	0	0
South Africa	33,747	17	10	2,000e	2,160e	85	1,260	1,309	1,230	1,220	1,581	1,661	1,840	1,885
Sudan	23,797	2	0	7	0	3	26	29	0	0	10	10	0	0
Swaziland	737	1	1	5e	180	9	2	3	-3	5	2	3	180	178
Tanzania	25,397	2	4	69	76	1	14	16	37	35	32	30	37	35
Togo	3,247	0	0	0	0	<1	0	0	0	0	0	0	0	0
Tunisia	7,809	5	1	50e	25e	27	90	97	30	30	30	37	20	20
Uganda	17,189	1	0	5e	0	1	7	7	2	2	2	2	0	0
Zaire	33,755	1	0	4e	0	1	11	11	2	2	3	3	0	0
Zambia	7,851	1	0	30	0	1	7	5	0	0	3	5	0	0
Zimbabwe	9,125	3	2	90	41	22	84	90	59	62	80	82	37	40
Africa	**604,442**	**89**	**36**	**3,092**	**3,103**	**12**	**3,222**	**3,319**	**1,787**	**1,754**	**2,355**	**2,445**	**2,474**	**2,526**
TOTAL WORLD	**5,110,362**	**4,185**	**1,160**	**245,126**	**172,361**	**96**	**213,871**	**224,056**	**154,023**	**159,365**	**215,167**	**226,329**	**154,478**	**160,551**

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by less than half of one percentage point to 10.5 million tons. But, on the basis of good export sales, pulp production rose a more healthy 3% to 7.3 million tons.

The overall picture in 1989 is one of contrasts. Ingrained economic problems in many countries are retarding industry development. Yet investment activity in the pulp and paper industry has never been stronger, with large amounts of foreign money flowing in.

Brazil, the continent's dominant producer, is the key example of this paradox. Its economy is stalled, with inflation apparently out of control, its foreign debt running above $100 million, and its financial, social, and political institutions too weak to do anything about it. In 1988, the overall industrial growth index of the country fell by 3.2%. Nevertheless, pulp and paper industry investment plans valued at $8.8 million are on the drawing board and will double production by 1995. The reasons for investor confidence despite the poor showing of the industry are clear: Brazil has the fastest-growing pulpwood trees in the world. And its pulp and paper industry is now a recognized and established exporter, earning $1.4 million of Brazil's balance-of-payments surplus of $19 million.

Among the most noticeable expansion projects are Aracruz Celulose SA's 520,000-tpy expansion to 1 million tpy by the end of 1991, Cenibra SA's new 350,000-tpy line, and Bahia do Sul's 420,000-tpy pulp mill for startup in 1992. Other projects include Copener/Riocell's 340,000-tpy mill, for which a third partner is being sought, and a project formulated by a consortium of nonintegrated papermakers for a 350,000-tpy mill, which is believed to be at an advanced stage. Other proposals are under discussion, including a plan by Champion International Corp.'s Brazilian subsidiary to build a new pulp and printing/writing papers mill in the state of Mato Grosso do Sul as well as preliminary studies by Jari to double capacity in the late 1990s.

New paper machines are also being planned by Ripasa SA, which is building a 145,000-tpy paper machine with 70% of the output destined for export, and Grupo Votorantim, which is installing two paper machines at the former Guatapara mill. Pisa, part of the New Zealand group Fletcher Challenge, is building a new newsprint paper machine for startup in 1994. The booming export business is attracting newcomers to the industry. Most noticeable is Inpacel, a subsidiary of a bank, which is to begin pine chemithermomechanical pulp (CTMP) and mechanical printing paper production in 1991.

The investment boom is not limited to Brazil. Even in Argentina, which arguably is Latin America's most turbulent economy, some reason for optimism exists. Most prominent is a project between domestic company Arcor, Citicorp, and BAT Industries to build a new 300,000-tpy eucalyptus pulp mill in the Entre Rios province. Canadian interest has also been strong, with Consolidated-Bathurst Inc. combining with two domestic companies to study a 100,000-tpy CTMP mill

Across the border, in the more stable economic climate of Chile, three major projects are pressing ahead. Shell International, Scott Paper Co., and Citibank have combined to build the 265,000-tpy Santa Fe pulp mill for startup in 1992. It will be the first mill in Chile to use plantation eucalyptus. The rest of the industry is based on radiata pine. Celulosa Arauco y Constitucion has also given the green light to a major new pulp line at its Arauco mill. Also for startup by the end of 1992, it will make 350,000 tpy of bleached kraft pulp. Chile's other major company, CMPC, has teamed up with Simpson Paper Co. for its major project—a 315,000-tpy bleached kraft pulp mill, Celulosa del Pacifico, which should start up by the end of 1990.

Further north, Venezuela is investing $300 million in new plant and equipment. Among the investments are Cartonera del Caribe Cia.'s new 50-tpd packaging board paper machine, an extra 30,000 tpy of capacity at Smurfit Cartones Nacionales SA, and an extra 90,000 tpy of capacity at Venepal. Colombia, meanwhile, is planning marginal increases in capacity in 1989, with the startup of the 87,000-tpy Papelcol SA mill in 1990.

The performance of Central America is dominated by Mexico. In 1988, the Mexican economy showed some positive signs, with a modest GNP growth of 1.1% and a rapid fall in inflation due to austerity measures. But the massive debt problem persists. Under these circumstances, paper and board output rose slightly to 2.6 million tons, and consumption rose 3.6%, largely fueled by imports. Several large projects are planned, and some of the output will be destined for export. Industrias Centauro's 250,000-tpy linerboard machine should start up in 1989. Grupo Durango is building a second pine market CTMP line near Durango City. Capacity will be 75,000 tpy. An 80,000-tpy fine paper machine will be installed by Ponderosa Industrial at Celulosa de Chihuahua mill.

The outlook for Latin America for late 1989 and 1990 hinges on finding solutions to the region's long-term economic problems. If that can be done, the current interest of foreign investors could become a flood of venture capital.

FAO OUTLOOK TO 1995

In its *Outlook for Pulp and Paper to 1995*, issued in 1987, the Food and Agriculture Organization of the United Nations estimated that worldwide production of paper and paperboard in 1984 accounted for 1% of total world economic activity—$100 billion, 187 million metric tons consumed. The industry was viewed as one that will continue to grow, at least into the mid-1990s, with demand rising to 246 to 255 million tons by 1995 and consumption increasing by 59 to 68 million tpy—an annual growth rate of 2.6% to 2.9%. Production capacity projected to 1995 will be adequate to meet demand, as will supplies of raw materials.

Per capita consumption of paper and paperboard was estimated at 55 lb (25 kg) in 1960, 84 (38) in 1984, and was forecast to reach 97 (44) in 1995.

Pulp consumption will increase from 140 million tons in 1984 to 177 to 181 million tons by 1995, according to the study. The ratio of pulp per ton of paper will decrease from 0.74 to 0.72 as wastepaper consumption rises from 49 million tons to 83 to 85 million tons by 1995. At that time, wastepaper will account for 32% of total fiber supply.

World trade in pulp and paper reached about $30 billion in 1984, 1.5% of total merchandise exports, and included 39 million tons of paper and board, 21 million tons of mechanical and chemical pulps, and four million tons of wastepaper. Countries in the developing economies accounted for $4 billion of this, or 1% of their total imports.

The world market is made up of some 150 importers. Of these, 75 have some production and 45 also export. Of the 75 countries relying on imports, 70 are developing countries. Most of the exports, or 66%, are now supplied by five of the exporting countries. However, developing countries are increasing their production and sometimes becoming exporters, particularly of pulp. The trend is for developing countries to trade among themselves. The FAO expects these countries to increase their self-sufficiency. In 1954, developing countries imported 1.4 million tons and exported 50,000; in 1984, the figures were 6.6 million tons and 1.0 million, respectively. Product mix has also changed. Newsprint, for example, accounted for two-thirds of total volume in 1954, and by 1984 for only one-third.

Participants in the FAO study included an Advisory Committee of Experts on Pulp and Paper, an Industry Working Party (IWP), the FAO Secretariat, and consultants. Results are frequently compared to the Chase Econometrics 1986 Long-Term Report. The paper/paperboard sector was divided into three large groups by grade.

Newsprint. World production was estimated at 29.2 million tons in 1984, and growth rates of 2.8% to 3.1% were projected to 1995, with consumption being 39.3 to 39.7 million tons at that time. The IWP estimated that world consumption of newsprint in 1995 would be lower, 36.4 million tons. Actual increases will depend on the development of electronic media, lower grammage weights, and the use developing countries make of newsprint—often for text, forms or other purposes.

Printing/writing paper. Consumption in this sector was projected to grow from 48.8 million tons in 1984 to 75.5 million tons by 1995, an average annual growth rate of 4.7%. The IWP, however, forecasted only 67.7 million tons, predicting an end to the rapid growth of special-interest magazines, and citing the flat outlook for directories, the expansion of television advertising and encroaching electronic communications. Office paper use will increase, but basis weights will go down as postal rates go up. Printing/writing papers will be used increasingly by developing countries and by centrally planned economies.

Other paper and paperboard. This sector accounted for 59% of total paper and paperboard consumption in 1984—109.2 million tons. A growth rate of 2.1% to 2.8% to 1995 was predicted, or 132.9 to 139.4 million tons. As with newsprint, the growth rate will be slower in developed countries than in other economies. The developing and planned economies may bypass some packaging stages the developed countries experienced, going directly to plastic or to metal containers.

TOTAL WORLD PAPER/BOARD CONSUMPTION AND PRODUCTION PROJECTIONS TO 1995

(million metric tons)

FAO regions and subregions	Consumption					Production				
	Actual	FAO		Chase		Actual	FAO		Chase	
	1984	1990	1995	1990	1995	1934	1990	1995	1990	1995
Developed market economies	144.4	156.1	177.1	155.9	172.7	150.2	169.5	196.4	168.8	190.6
North America	73.4	76.1	82.6	78.3	84.6	76.5	83.5	93.2	87.7	97.0
West Europe	46.7	50.6	58.9	50.4	56.8	49.9	56.3	66.1	54.0	62.0
Oceania	2.5	2.8	3.2	2.9	3.3	2.2	2.4	2.9	2.3	2.6
Others	21.6	26.5	32.2	24.2	27.9	21.4	27.2	34.0	24.6	28.8
Developing market economies	20.1	27.9	37.0	26.5	34.7	15.3	17.2	22.1	16.5	21.3
Africa	0.8	1.1	1.4	1.1	1.3	0.3	0.4	0.5	0.4	0.5
Latin America	9.7	13.3	17.0	11.9	15.2	8.6	10.0	12.5	7.9	10.1
Near East Africa	0.4	0.7	0.9	0.6	0.7	0.1	0.1	0.1	0.1	0.2
Near East Asia	1.3	1.7	2.2	1.6	2.1	0.6	0.7	1.0	0.8	1.0
Far East	7.7	10.9	15.2	11.1	15.2	5.5	5.8	7.8	7.1	9.4
Centrally planned economies	22.8	31.8	40.6	31.5	38.5	22.0	29.1	36.2	28.6	33.8
Asia	7.5	12.1	16.2	14.5	20.0	7.0	10.5	13.7	12.3	16.2
Europe, U.S.S.R.	15.2	19.7	24.4	16.9	18.4	15.0	18.5	22.5	16.3	17.6
World	187.3	215.9	254.8	214.0	245.9	187.6	215.9	254.8	214.0	245.9

Source: United Nations Food & Agriculture Organization's Outlook Study.

WORLD PAPER AND BOARD CAPACITY

(000 metric tpy)

	Capacity		Average annual increase (%)	
	1988	1993	1983-88	1988-93
World total	242,570	279,247	3.3%	2.9%
Developed market economies	185,686	214,648	2.8	2.9
North America	90,747	102,912	2.2	2.5
Japan	27,143	31,554	3.2	3.1
Western Europe	62,997	75,166	3.6	3.6
Oceania	2,758	2,930	1.9	1.2
Others	2,041	2,086	4.0	0.4
Developing markets	24,889	30,850	5.8	4.4
Africa	1,048	1,202	2.6	2.8
Latin America	12,868	15,870	4.7	4.3
Asia	10,973	13,778	7.6	4.7
Centrally planned economies	31,995	33,749	4.4	1.1
Asia	13,632	13,632	18.5	0.0
Eastern Europe	6,763	7,317	1.0	1.6
U.S.S.R.	11,600	12,800	-3.0	2.0

Source: United Nations Food & Agriculture Organization.

1988 PAPER, BOARD, AND PULP PRODUCTION IN WESTERN EUROPE

(000 metric tons)

Country	Paper and board production	% change 1988/87	Pulp production	% change 1988/87
Austria	2,650	12.4%	1,320	9.5%
Belgium	1,133	10.0	467	27.6
Denmark	343	6.2	95	17.3
Finland	8,654	8.0	8,849	6.1
France	6,313	8.2	2,182	4.7
Fed. Rep. Germany	10,567	6.6	2,218	4.8
Italy	5,353	7.3	788	6.8
Netherlands	2,462	13.6	184	36.3
Norway	1,670	5.1	1,876	4.6
Portugal	690	10.0	1,472	4.5
Spain	3,408	4.8	1,526	(4.5)
Sweden	8,160	4.2	10,306	3.3
Switzerland	1,216	6.0	336	3.7
U.K.	4,294	2.7	450	15.4
Total	56,913*	6.9	32,069	5.0

* Excludes 34,000 tons from Ireland.

Source: European Paper Institute.

FAO CAPACITY SURVEY

World capacity for paper and paperboard will increase at an average annual rate of 2.9% to 279.4 million metric tons during 1988-93, according to the 1988-93 survey of pulp and paper capacity by the Food & Agriculture Organization of the United Nations. This compares with a 3.3%/year increase from 1983-88.

In 1988, world capacity was 242.5 million tons, about 76% of which was located in developed economies. This percentage will not change much by 1993. Newsprint capacity will increase at an average annual rate of 3.6% to 40.78 million tons by 1993. About 83% of this capacity will be in the developed world. Printing/writing papers capacity will rise 3.8%/year during the period to 81.3 million tons. Again, over 80% of this capacity is in developed markets. Growth for this grade will actually slow from the 5.6%/year rate of 1983-88.

Total world capacity for paper-grade woodpulp will rise 2.5%/year to 181.6 million tons by 1993. This compares with a 2.2%/year increase during 1983-88. Capacity in 1988 was 160.1 million tons. The grade breakdown is as follows: mechanical, 40.6 million metric tons; semichemical, 9.6; chemical, 109.3; other fiber pulp, 15.4; and dissolving pulp, 5.1. Mechanical pulp will have the strongest growth rate during 1988-93 at 3.1%/year, with most of the capacity coming on between 1988 and 1991. Chemical pulp capacity will grow 2.4%/year.

WORLD PAPER-GRADE WOODPULP CAPACITY

(000 metric tpy)

	Capacity		Average annual increase (%)	
	1988	1993	1983-88	1988-93
World total	160,174	181,585	2.2%	2.5%
Developed market economies	132,157	147,755	2.2	2.3
North America	80,581	89,792	2.1	2.2
Japan	12,847	14,407	1.4	2.3
Western Europe	34,577	39,206	2.5	2.5
Oceania	2,702	2,900	3.0	1.4
Others	1,450	1,450	11.9	0.0
Developing markets	10,515	15,859	4.6	8.6
Africa	906	1,092	4.6	3.8
Latin America	7,011	11,747	3.9	10.9
Asia	2,598	3,020	6.6	3.1
Centrally planned economies	17,502	17,971	0.4	0.5
Asia	1,885	1,885	10.1	0.0
Eastern Europe	4,332	4,451	0.1	0.3
U.S.S.R.	11,235	11,635	-0.7	0.7

Source: United Nations Food & Agriculture Organization.

GLOSSARY OF INDUSTRY TERMS

Reprinted from *Pulp & Paper Dictionary* by John R. Lavigne (Miller Freeman Publications, 1986).

A

ABRASION RESISTANCE. Ability of a paper product to withstand abrasion. Measured by determining degree and rate that a sample loses weight under specific rubbing action of an abrading substance, such as an eraser.

ABSORBENCY. Property of pulp, paper, and its constituents and products that permits the entrainment and retention of other materials it contacts, such as liquid, gaseous, and solid substances.

AIR DRY (a.d.). Weight of moisture-free pulp or paper plus 10% moisture based on traditional assumption that this amount of moisture exists when they come into equilibrium with the atmosphere.

ALUM. Papermaking chemical commonly used for precipitating rosin size onto pulp fibers to impart water-resistant properties (when used for water treatment) to the paper. Also called *aluminum sulfate*.

ANTITARNISH PAPER. Term originally applied to higher-weight tissues used for wrapping silverware, but now used for all papers so prepared that they will not rust or discolor razor blades, needles, silverware, etc.

APPARENT DENSITY. Weight (mass) per unit volume of a sheet of paper obtained by dividing the basis weight by the caliper (thickness).

B

BASESTOCK. Paper or board to be further treated in various ways.

BASIS WEIGHT. Weight in pounds of a ream of paper, usually consisting of 480, 500, or 1,000 sheets of a specified size.

BEATER. Large, longitudinally partitioned, oval tub used to mix and mechanically "work" pulp with other ingredients to make paper.

BEATING. See *refining*.

BINDERS BOARD. Gray-colored, glazed board often used in the binding of hardcover books.

BIOLOGICAL OXYGEN DEMAND (BOD). Amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter in mill effluent.

BISULFITE PULP. Pulp made by the bisulfite cooking process using bisulfite cooking liquor.

BOGUS. Product that has been made from wastepaper or other inferior materials to imitate higher-quality grades.

BOND. Class of printing/writing papers made from bleached chemical woodpulps and cotton fibers.

BONDING STRENGTH. Intralayer binding force in a multi-ply paperboard or laminate. Also refers to the degree of adherence of coating and film on a sheet and to the interfiber binding force within a sheet.

BONE DRY (b.d.). (1) Descriptive term for the moisture-free conditions of pulp paper. See *oven dry*. (2) Refers to air containing no vapor.

BOOK PAPER. Paper suitable for printing and other uses in the graphic arts industry.

BRIGHTNESS. Measure of the degree of reflectivity of a sheet of pulp or paper for blue light measured under specified standard conditions. Also called *whiteness*.

BRISTOLS. Heavy-grade papers possessing higher-than-average quality characteristics. Rigid enough to be used for announcements, invitations, postcards, etc.

BROKE. Paper trimmings or damaged paper due to breaks on paper machine and in finishing operations.

BULK. Compactness property of a sheet in relation to its weight (whose value decreases as compactness increases).

BURSTING STRENGTH. Resistance of paper to rupture when pressure is applied to a side by a specified instrument. Also called *burst*, *mullen*, and *pop strength*.

C

CALENDER. Piece of processing equipment located at dry end of paper machine, consisting of a set of rolls through which paper sheet is passed for smoothing, leveling, and gloss improvement.

CALENDER FINISHED. Paper and paperboard passed through a calender to improve surface characteristics by application of pressure, friction, or moisture.

CALIPER. Thickness of a sheet of paper or paperboard, measured under certain specifically stated conditions, expressed in units of thousandths of an inch (called "mils" when referring to paper, "points" when referring to paperboard). Also called *thickness*.

CARBONIZING PAPER. Lightweight, uncoated paper made from unbleached chemical and/or mechanical pulps and surface-coated with a carbon solvent or wax so that it takes up carbon inks and releases them under pressure, thereby duplicating the inked areas being printed.

CARBONLESS PAPER. Copying paper that is treated or coated so it can be used without needing carbon coating or interleaved carbon paper.

CARLOAD. Quantity of paper shipped from mill in one freight car. Must exceed a freight classification zone minimum weight to qualify for carload freight rate.

CAST-COATED PAPER. Very high-gloss coated paper and paperboard with surface characteristics produced by allowing applied coating to harden while in contact with surface of steam-heated, highly polished, chrome-plated drum.

CELLULOSE. Chief substance in cell walls of plants used to manufacture pulp.

CELLULOSE WADDING. See *wadding*.

CHEMICAL PULP. Mass of fibers resulting from reduction of wood or other fibrous raw material into component parts during cooking phases with various chemical liquors in processes such as sulfate, sulfite, soda, and NSCC.

CHEMI-THERMOMECHANICAL PULP (CTMP). Pulp made by thermomechanical process in which woodchips are pretreated with a chemical, usually sodium sulfite, either prior to or during presteaming as an aid to subsequent mechanical processing in refiners.

CHIPBOARD. Inferior-quality, low-density, solid or lined paperboard made primarily from recycled wastepaper stock and used in low-strength applications.

CLARIFIERS. Storage tanks in which suspended solids are allowed to settle and be removed from green and white liquors in the causticizing areas of a pulp mill.

COATED. Papers and paperboards that contain a layer of coating material, such as clay or pigment, in combination with an adhesive.

COMBINATION BOARD. Multi-layered, cylinder-made paperboard having outer and inner layers made from different pulpstocks.

COMBINED BOARD. Multi-layered board made by uniting a number of boards with proper adhesives.

CONSTRUCTION PAPER. Heavy type of paper used for watercolor and crayon artwork, made in various colors primarily from groundwood pulp.

CONTAINERBOARD. Single- and multi-ply, solid, and corrugated boards used to make boxes and other containers for shipping materials.

COOK. Process of reacting fiber-containing materials, such as wood, rag, straw, and bagasse, with suitable chemicals, usually under high temperature and pressure, in order to reduce them into component parts so that acceptable fibers can be separated and made into pulp.

CORD. Pulpwood volume measurement indicating a pile measuring 4 ft x 4 ft x 8 ft, equaling 128 ft^3 (3.62 m^3).

CORRUGATED BOARD. (1) A pasted, single- or double-faced, multi-layered board having a fluted bottom or middle layer. (2) The fluted paperboard after it has gone through the corrugating operation and before it is pasted to the flat facing board sheet.

CORRUGATING MEDIUM. Paperboard made from chemical and semi-chemical pulps, sometimes mixed with straw or recycled paperstock, that is to be converted to a corrugated board by passing it through a corrugating machine.

COVER PAPER. Paper used as a protective covering for books, pamphlets, magazines, catalogs, and boxes.

CREPE PAPER. Low-basis-weight paper made from sulfite, sulfate, or mechanical pulp and given a simulated crinkly finish by crowding the web sheet over a roll with a doctor blade.

CROSS DIRECTION (CD). Side-to-side direction of a paper machine or the paper sheet made on it, as opposed to *machine direction*, which runs from head to exit end.

CUNIT. Pulpwood measurement equivalent to a volume containing 100 ft^3 solid of unpeeled wood.

CURL. Paper or paperboard deformation caused by nonuniform distribution of strains and stresses throughout the sheet as a result of uneven internal moisture and conditioning.

CUT SIZE. Fine paper cut to specific end-use dimensions (16 in. x 21 in. or less) on a paper trimmer usually of the guillotine or rotary type.

CYLINDER MACHINE. Machine primarily used to make paperboards. The forming cylinders are covered with wire so that, as they turn within a vat filled with stock solution, fibers are picked up to form a web on the surface with water draining through and passing out at the ends. The wet sheet is then transferred off the cylinder onto a felt for possible combining with other sheets (multiple cylinders on same machine) and subsequent pressing and drying.

D

DEINKING. Removal of ink and other undesirable materials from wastepaper by mechanical disintegration, chemical treatment, washing, and bleaching before reusing as a source of papermaking fiber.

DIE CUT. Paper and paperboard products cut by a metallic die to specified dimensions or form.

DIGESTER. Pressure vessel used to chemically treat chips and other cellulosic fibrous materials such as straw, bagasse, rags, etc., under elevated temperature and pressure in order to separate fibers and produce pulp.

DIMENSIONAL STABILITY. Ability of a sheet to maintain its original machine and cross-machine dimensions with time and under variable moisture and relative-humidity conditions.

DRY END. Portion of a paper machine where sheet moisture is removed by evaporation. Consists of several dryer sections or air dryers, depending on type and size of the machine.

DRYERS. Portion of a paper machine where water is removed from wet paper by passing it over rotating, steam-heated, cylindrical, metal drums or by running it through a hot air stream.

DUPLEX. (1) Papers and paperboards with each side having a different color, finish, or surface texture, which is produced on the paper machine or by pasting. (2) General term referring to multi-ply paper and paperboard and to bags made of two separate sheets of paper.

E

ELECTROSTATIC COPY PAPER. Smooth-finished, stable, medium-weight bond paper made from chemical pulps. Generally treated with a zinc oxide coating material and used on dry-type office copying machines.

ELMENDORF TEST. Test commonly used in paper mill laboratories to determine tear-resistant property of paper. Also called *tear test*.

ELONGATION. Physical property of a paper sheet that allows it to experience a certain degree of stretching.

EMBOSSED. Paper finish obtained by mechanically impressing a design on the sheet with engraved metallic rolls or plates.

ENAMEL. Clay coating on coated paper.

ENGLISH FINISH. Medium finish applied to a sheet of paper that is smoother than the finish coming off dryers or calenders, but not as smooth as the finish coming off supercalenders.

F

FABRIC PRESS. Paper machine wet press that uses a special multiple-weave fabric belt sandwiched between the regular felt and the rubber-covered roll, increasing the capacity to receive and remove water from the nip between rolls.

FEEL. Evaluation of paper surface finish by sense of touch.

FELT. Woven belt of wool, cotton, or synthetic fibers used to transport sheet of paper between rolls of press section (wet felt) and against dryer drum (dryer felt) in dry-end section of paper machine.

FELT SIDE. Top side of paper sheet as it is formed on wire of wet end of paper machine, which later comes in contact with felts during subsequent drying phases.

FIBER. Elongated, tapering, thick-walled cellular unit that is the structural component of woody plants.

FILLER. (1) Substance added to pulpstock to fill spaces between fibers and enhance printing properties of paper made from it. (2) Inner layers of multi-ply paperboards.

FINE PAPERS. High-quality printing/writing and cover papers having excellent surface characteristics for pen and ink writing.

FINISH. Surface characteristics of sheet of paper, such as smoothness, appearance, and gloss, as determined visually.

FINISHING. Processing of paper after completion of papermaking operations, including supercalendering, slitting, rewinding, trimming, sorting, counting, and packaging prior to shipment from mill.

FLEXOGRAPHIC PRINTING. Rotary letterpress printing process using ink made of aniline dyes and pigments (mixed with a binder) that dries primarily by evaporation due to the solvent vehicle (with rapid evaporation properties) used. Also called *aniline printing*.

FLUFF PULP. Thick sheet or batt of woodpulp fibers manufactured in roll or bale form and suitable for dry disintegration into individual fibers.

FLUORESCENT PAPER. White paper made with synthetic dyes that produce a brighter appearance by increasing the ability to reflect light, or paper that is surface-coated with colored, light-emitting dyestuff materials (which reflect white light as a color).

FORMATION. Physical distribution and orientation of fibers and other solid constituents in the structure of a sheet of paper that affects its appearance and other physical properties.

FOURDRINIER WIRE. Continuously traveling, endless, woven, metallic, or plastic screen belt located in wet-end section of fourdrinier paper machine. Pulpstock is fed onto wire so that water is drained from it as fibers become oriented to form a continuous web.

FREENESS. Ability of pulp and water mixture to release or retain water on drainage.

FREE-SHEET. Sheet of paper containing no mechanical pulp fibers or made of pulp subjected to minimal refining or hydration, which allows water to drain quickly when sheet is formed on fourdrinier wire. Also called *woodfree*.

FURNISH. Various pulps, dyes, additives, and other chemicals blended together in stock preparation area of paper mill and fed to wet end of paper machine to make paper or paperboard. Also called *stock*.

G

GLASSINE. Light, dense, translucent paper made from highly refined chemical pulp and possessing a high degree of hydration. Used as envelope windows and in protective packaging for foodstuffs, candy, tobacco products, chemicals, and metallic items.

GLOSS. Property of paper sheet surface that produces a shiny, highly reflective appearance when light is reflected from it.

GRAIN. Directional alignment of fibers in a paper sheet structure.

GRAVURE PRINTING. Intaglio printing process employing minute engraved "wells." Generally, deeply etched wells carry more ink than a raised surface; hence, they print darker values. Shallow wells are used to print light values. A doctor blade wipes excess ink from the cylindrical printing surface. Rotogravure employs etched cylinders and web-fed stock. Sheet-fed gravure, as its name implies, involves individual sheet feeding.

GROUNDWOOD PAPER. Paper that is made from a furnish containing a large percentage of groundwood pulp.

GROUNDWOOD PULP. Slurry produced by mechanically abrading fibers from barked logs through forced contact with the surface of a revolving grindstone. Used extensively to make newsprint and publication papers.

H-K

HARD-SIZED. Paper and paperboard made resistant to water and ink penetration by exposure to high degree of sizing treatments.

HARDWOOD. Pulpwood from broad-leaved dicotyledonous deciduous trees.

HEMICELLULOSE. Alkali-soluble, noncellulosic polysaccharide portion of a wood cell wall.

HOLDOUT. Ability of paper or board to resist surface liquid penetration.

HOTMELTS. Plastic or wax coating materials in a molten state applied to paper or paperboard sheet to produce fluid-resistant surface with high gloss.

INDUSTRIAL PAPERS. Paper made for purposes such as industrial packaging, tissues, wrappings, impregnating, insulating, etc.

INTEGRATED MILL. Mill manufacturing complex in which all pulp and papermaking operations are conducted at one site.

INTERNAL BONDING STRENGTH. See *bonding strength*.

JOB LOT. Out-of-specification, defective, or discontinued types of paper made in small quantities for special orders and sometimes sold at lower-than-standard prices.

JUMBO ROLL. (1) Larger-than-normal roll of paper as it is slit and rewound. (2) Roll of paper usually greater than 12 in. in diameter and used for converting into user products.

KRAFT PAPER. High-strength paper made from sulfate pulp, usually with a naturally brown color from unbleached pulp. Also called *sulfate paper*.

KRAFT PULP. Fibrous material used in pulp, paper, and paperboard manufacturing, produced by chemically reducing woodchips into their component parts by cooking in a vessel under pressure using an alkaline cooking liquor. Also called *sulfate pulp*.

L

LACQUER. Organic solution with volatile solvents used for coating paper to give high surface gloss, grease resistance, heat sealing, and improved surface appearance.

LAMINATED PAPER. Multi-ply paper and paperboard consisting of firmly united, superposed layers, which may be bonded with resin or adhesive.

LEDGER PAPER. Strong, highly sized paper made from bleached chemical woodpulp. Used to make accounting and record books; also used with accounting machines.

LETTERPRESS PRINTING. Printing process in which ink is applied to paper, paperboard, or film from raised portions of printing plates or type.

LIGNIN. Brown organic substance that acts as an interfiber bond in woody materials.

LINERBOARD. Kraft paperboard, generally unbleached, used to line or face corrugated core board (on both sides) to form shipping boxes and various other containers.

M

MACHINE-COATED. Paper and paperboard that have surface coating of adhesives and minerals applied while being made on the paper machine, as an integral part of the papermaking operation.

MACHINE-DIRECTION (MD). Direction from the wet end to the dry end of a paper machine or to a paper sheet parallel to its forward movement on a paper machine.

MACHINE-FINISH (MF). Surface finish produced on an uncoated sheet of paper as it is being made on the paper machine, and usually accomplished with limited calendering on the machine calender stacks.

MACHINE-GLAZED (MG). High-gloss surface finish produced on the wire side of a sheet by passing it over a large-diameter, highly polished, steam-heated roll as used on yankee-type paper machine dryers.

MANIFOLD PAPER. Very thin regular bond paper with glazed or unglazed finish used to make carbon copies of letters.

MATTE. Paper and surface finishes with very low gloss or luster.

MECHANICAL PULP. Pulp produced by reducing pulpwood logs and chips into their fiber components by the use of mechanical energy, via grinding stones, refiners, etc.

MEDIUM. See *corrugating medium*.

MOISTURE CONTENT (MC). Percent of water by its weight in paper, pulp, paperboard, chips, etc., which will vary according to atmospheric conditions because of the ability of these types of materials to absorb or emit moisture.

MOISTUREPROOF. Ability of paper and paperboard to resist the penetration of water vapor.

MOISTURE VAPOR TRANSMISSION. Ease or rate of water vapor permeation in a sheet of paper.

MOTTLE. (1) Random nonuniformity in printed gloss, or the visual density or color of a printed area caused by uneven absorption of ink by paper. (2) A surface effect produced by the addition of heavily dyed fibers of a different color in the stock furnish.

MULLEN. See *bursting strength*.

MULTI-PLY. Paper or paperboard sheet made up of two or more layers.

N-O

NEWSPRINT. Grade of paper, combining high percentages of groundwood pulp, made especially for use in the printing of newspapers.

NINEPOINT. Paperboards with a thickness of 9 mils (0.009 in.) used as the fluted component in the manufacture of multi-ply combined board or wrapping. See *corrugating medium*.

NONWOVEN FABRIC. Sheet of cloth-like material made from long natural and synthetic fibers and formed from a slurry on a wire screen, such as a wet end of a paper machine, or by laying on a fine mesh screen from an air suspension.

OFF-MACHINE COATING. Process of applying coating material to a sheet of paper or paperboard in a location that is away from the machine on which it is made.

OFFSET PRINTING. Process of indirect printing in which an impression of type or a design on a flat plate is printed on a rubber-blanketed cylinder from which it is impressed ("off-set") upon the surface to be printed.

ONIONSKIN. A thin, lightweight, transparent paper made especially for producing typewritten copies of correspondence.

OPACITY. Ability of substances such as paper, flue gases (smoke), and liquids to resist transmission of both diffuse and nondiffuse light through them. Prevents show-through of dark printing in contact with backside of sheet of paper.

OVEN-DRY (o.d.). Moisture-free conditions of pulp and paper. Usually determined by drying a known sample to a constant weight in a completely dry atmosphere at a temperature of 100°C to 105°C (212°F to 221°F). Also called *bone dry*.

P

PAPER. Homogeneous sheet of felted cellulose fibers, bound together by interweaving and by the use of bonding agents, and made in a variety of types.

PAPERSTOCK. Water slurry of various pulp fibers, dyes, additives, and chemicals that is pumped to the paper machine for forming into a sheet.

PAPETERIE. Chemical pulp and cotton-fiber content paper, made especially for conversion to a class of writing types, usually correspondence stationery.

PATENT COATED. Type of paperboard that is made and lined with white or colored fibers on a multi-cylinder machine, possessing a high surface finish suitable for use in making cartons.

PICK. (1) Phenomenon of pulp or fibers pulling away and sticking to paper machine parts, such as rolls, in the wet and dry end sections. (2) Paper mill control test to determine surface adhesion properties of paper. (3) Small particles of paper that loosen from the surface of paper, especially during printing.

PIGMENT. An insoluble mineral or organic powder used as a dye to color paper and as an additive to impart specific properties—bulk, porosity, opacity—to the sheet.

PLY. Layer that makes up a multi-layered, pasted, or multi-cylinder-formed paperboard.

POINT. Measurement of thickness of a sheet of paper or board (0.001 in.).

POROSITY. Ability of fluids to pass through paper and paperboard, related to size, shape, and distribution orientation of the pores in a sheet and the compactness of the fibers.

PRESSURE-SENSITIVE PAPER. Good-strength paper coated with a pressure-sensitive type of adhesive and converted to tapes and labels.

PRINTABILITY. Ease with which paper can be printed to high-quality standards with the least amount of spoilage.

PULP. Fibrous material produced by mechanically or chemically reducing woody plants into their component parts from which pulp, paper, and paperboard sheets are formed after proper slushing and treatment. Also used for dissolving purposes (dissolving pulp or chemical cellulose) to make rayon, plastics, and other synthetic products. Also called *woodpulp*.

R

RAG CONTENT. Paper containing from 25% to 75% cotton or rag fibers, including bond, ledger, and specialty papers.

REAM. Stack or package of paper containing a number of sheets (usually 480, 500, or 1,000) designated as standard for that grade.

REFINER MECHANICAL PULP (RMP). Pulp made by processing untreated woodchips in mechanical atmospheric refiners.

REFINING. Pulp and paper mill operations conducted of fiber suspensions to rub, brush, crush, fray, or cut fibers as desired. Imparts such characteristics as increased capacity to absorb water and improved sheet formation.

REGISTER PAPER. Lightweight writing grade made from chemical pulp and possessing good tensile and tearing strength. Comes in rolls especially for automatic register machines and in flat, folded, snap-apart packages for computer printouts and other copying purposes.

RELATIVE HUMIDITY. Actual amount of water vapor present in the air as compared with the maximum amount of water vapor the air could hold at that temperature.

RELEASE PAPER. Type of paper made especially for easily removal from sticky surfaces.

ROSIN. Material made up of a suspension and used for internal sizing of paper and paperboard.

ROTOGRAVURE PRINTING. See *gravure printing*.

RUNABILITY. (1) In the paper mill, how well pulp stock furnish to the paper machine forms a sheet on the wire and passes through the drying and finishing operations. (2) Used by customers in reference to how well the paper performs in their converting operations, such as on printing presses.

S

SCREENINGS. Rejected materials, such as knots, shives, and large bark particles, from the screening operations of pulp suspensions in a pulp mill.

SECONDARY FIBER. Any type of paper- and paperboard-making fiber obtained from wastepapers and other used, reclaimable fiber sources.

SEMICHEMICAL PULP. Lower-quality pulp made by cooking fibrous materials in a neutral sodium sulfite/sodium carbonate cooking liquor followed by a final separation of the fiber using unpressurized mechanical means.

SHEET. Flat piece of any type of pulp, paper, and paperboard having a variety of characteristics, sizes, and finishes.

SILVICHEMICALS. Chemical byproducts of the woodpulping process and other chemicals derived from wood.

SIZE. Substance such as rosin, gelatins, glues, starch, or waxes added to paperstock furnish or to the surface of a sheet in order to give water-resistant properties.

SIZE PRESS. Paper mill processing unit consisting of two usually rubber-covered rolls located between two dry end sections of the paper machine. Applies size solution to the surface of the paper sheet.

SLURRY. Liquid mixture consisting of suspended fibers, fillers, coating pigments, and other solid material in water or adhesive, used in the papermaking process.

SLUSH. Pulp stockwater suspension thin enough to flow or to pump through a pipeline, usually running about 1% to 6% consistency.

SODA PULP. Pulp made by the cooking of woodchips from deciduous or broadleaf trees in a sodium hydroxide or caustic soda solution.

SOFTWOOD. Wood obtained from evergreen, cone-bearing species of trees, such as pines, spruces, hemlocks, etc., which are characterized by having needles.

SOLID BOARD. Single-ply, homogeneous types of paperboards, made from the same stock throughout the sheet structure.

SPENT LIQUOR. Used cooking liquor in a chemical pulp mill that is separated from the pulp after the cooking process. Contains lignins, resins, carbohydrates, and other substances extracted from the material being cooked.

SPLICE. Joint made in a continuous sheet of paper with glue or adhesive tape when a break occurs in the web during winding or rewinding into a roll.

STANDARD CONDITIONS. Unless otherwise specified, assumed to be 29.92 in. of mercury and 70°F.

STARCH. Type of papermaking adhesive and sizing material made primarily from corn and potatoes. Produces a higher degree of rigidity in a sheet and improves the finish by causing the fibers to lie flat.

STIFFNESS. The ability of paper or paperboard to withstand bending or crushing forces.

STOCK. (1) Fibrous mixture that is made into paper. May consist of one or more types of beaten or refined pulps, with or without suitable fillers, dyes, additives, and other chemicals. Also called *furnish.* (2) Paper suitable for a particular use, such as coating raw stock, milk bottle stock, tag stock, etc.

SULFATE PROCESS. An alkaline pulp manufacturing process in which the active components of the liquor used to cook chips in a pressurized vessel are primarily sodium sulfide and sodium hydroxide, with sodium sulfate and lime being used to replenish these chemicals in recovery operations. Also called *kraft process.*

SULFITE PROCESS. An acid pulp manufacturing process in which chips are reduced to their component parts by cooking in a pressurized vessel using a liquor composed of calcium, sodium magnesium, or ammonia salts of sulfurous acid.

SUPERCALENDER. Auxiliary piece of papermaking equipment used on some paper machines to obtain a denser paper with a higher finish than paper obtained on a calender.

SURFACE-COATED. Any paper or paperboard sheet that has a coating material applied to one or both surfaces.

SURFACE-SIZED. Paper whose surface is treated with a sizing material after the sheet is formed on a paper machine, or in a separate, off-machine operation, occasionally after it has been internally sized.

SYNTHETIC FIBERS. Short filaments that are extruded or spun from synthetic resin materials and used in the manufacture of synthetic paper.

T

TACK. Sticky property of paper and paperboard adhesive and glue-coating materials.

TALL OIL. Byproduct made from the resins, fatty acids, and soap removed during the evaporation of sulfate black liquor.

TARNISHPROOF PAPER. See *antitarnish paper.*

TEAR STRENGTH. Resistance of a paper sheet to tearing, usually measured by the force required to tear a strip under standardized conditions.

TENSILE STRENGTH. Resistant property of a sheet to pull or stress produced by tension. Expressed as the force per unit width of a sample that is tested to the point of rupture.

TEST LINERBOARD. Types of paperboard that meet specific tests (Rule 41) adopted by the packaging industry to qualify for use as the outer facing layer for corrugated board, from which shipping containers are made.

TEXT PAPER. Good-quality, laid or woven book paper with a medium vellum-like finish.

THERMOMECHANICAL PULP (TMP). Pulp made by presteaming chips and reducing them into their fiber components during an initial mechanical treatment in refiners under elevated temperature and pressure. Subsequent refining done at atmospheric pressure.

TRANSPARENCY. Ability of paper to allow light rays to pass through it in such a manner that objects behind it can be clearly seen.

TRIM. Dimension of the widest sheet of paper that can be made on a paper machine, not including the edges (which are normally cut off).

TWIN-WIRE FORMER. Type of multi-ply paperboard machine having two wires (or fabrics) between which the sheet is formed.

TWO-SIDEDNESS. Visual difference between the top or felt side of a sheet of paper and the bottom or wire side.

V-Y

VEGETABLE PARCHMENT. Hard, dense sheet of grease-resistant paper, having a very high wet-strength property.

VELLUM FINISH. Smooth, dull finish applied to book and stationery paper surfaces to simulate sheets originally made from young calves' skin.

WADDING. Single- or multi-ply, loosely matted fiber sheet made from chemical pulp and used in packaging, thermal, and acoustical applications, and as a cushioning medium. Also called cellulose wadding.

WASTEPAPER. All types of used paper that provide a source of fiber for the manufacture of some papers, paperboards, and chipboards.

WEB. Continuous sheet of paper produced and rolled up at full width on the paper machine.

WET END. Section of the head end of a paper machine, which includes the headbox, wire, and wet press sections. Where the sheet is formed from the stock furnish and where most of the water is removed before entering the dryer section. Also called *wire end.*

WET MACHINE. Paper machine consisting essentially of a wire-covered cylinder rotating in a vat of pulpstock on which a mat of varying thicknesses is formed by drainage. These mats are removed either intermittently in thick sheets called laps, or continuously.

WET-STRENGTH PAPER. Paper in which the fiber constituents and/or the sheet are chemically treated to enhance resistance to tear, rupture, or disintegration after becoming saturated with liquids.

WET TENSILE STRENGTH. Resistance of a paper sheet to pull or stress produced by applied tension after it has become saturated with liquids.

WHITE PAPER. (1) Any paper made from pulpstock whose natural color has been corrected by the addition of blue, yellow, and red dyestuff. (2) To a printer, any paper sheet that is devoid of printing material.

WIRE. See *fourdrinier wire.*

WIRE MARKS. Small impressions produced on the bottom surface of a sheet of paper, caused by the mesh of the wire screen on which the wet web is formed in the wet end of a paper machine.

WIRE SIDE. Bottom side of a sheet of paper that comes in contact with the wire as the web is being formed in the wet end of a paper machine.

WOODFREE. See *free-sheet.*

YANKEE DRYER. Type of steam-heated paper dryer consisting of a large, revolving drum equipped with a felt to hold the sheet in contact with its highly polished surface. Commonly used for drying tissue-type papers.

METRIC CONVERSION GUIDE

Reproduced from *Metrication for the Pulp and Paper Industry* by Kenneth E. Lowe (Miller Freeman Publications, 1975).

CONVERSION LIST FOR NORTH AMERICAN AND METRIC UNITS

To convert	Into	Multiply by
acre	hectare	0.4047
Btu (mean)	joule	1.05587×10^3
centimeter	foot	0.03281
	inch	0.3937
cord	(see Forestry Terms)	
foot	centimeter	30.48
	meter	0.3048
gallon (U.S. liquid)	gallon (U.K.)	0.8327
	liter	3.785
gallon (U.K.)	gallon (U.S. liquid)	1.20094
	liter	4.545
horsepower (electric)	kilowatt	0.746
horsepower-hour	kilowatt-hour	0.7457
inch	centimeter	2.54
	meter	0.0254
joule	Btu	9.4845×10^{-4}
	calorie (mean)	0.23866
kilogram-mass	pound (avdp)	2.2046
	ton (metric)	0.001
	ton (short)	1.102×10^{-3}
kilometer	foot	3281
	mile (statute)	0.6214
kilowatt	horsepower (electric)	1.3405
kilowatt-hour	horsepower-hour	1.3410
liter	gallon (U.K.)	0.21998
	gallon (U.S. liquid)	0.2642
meter	foot	3.281
ounce (avdp)	gram	28.3495
	pound (avdp)	0.0625
pound (avdp)	kilogram	0.4536
pound/inch^2 (psi)	kilogram-force/cm^2	0.07031
square foot	square centimeter (cm^2)	929.0
	square meter (m^2)	0.09290
square meter	square foot (ft^2)	10.76
	square inch (in.^{2})	1550
ton (long)	ton (metric)	1.016
	ton (short)	1.120
ton (metric)	ton (long)	0.9842
	ton (short)	1.1023
ton (short)	ton (long)	0.89286
	ton (metric)	0.90718
yard	centimeter	9.144
	meter	0.9144

FACTORS FOR CONVERTING REAM AND BASIS WEIGHTS TO GRAMMAGE

Paper grade	Trade size 500-sheet ream (in.)[1]	Grammage (g/m^2) to ream or basis weight[1]	Ream weight[2] to grammage
Writing and printing	17 x 22	0.266	3.760
Demy size	$17^{1}/_{2}$ x $22^{1}/_{2}$	0.280	3.571
Blotting	19 x 24	0.324	3.083
Cover	20 x 26	0.370	2.704
Tissue (double-crown size)	20 x 30	0.427	2.343
Cardboard	22 x 28	0.438	2.282
Bristol and tag	$22^{1}/_{2}$ x $28^{1}/_{2}$	0.456	2.195
News and wrapping (3000 ft^2)	24 x 36	0.614	1.627
Book	25 x 38	0.675	1.480
Former standard size	25 x 40	0.711	1.406
Paperboard	1000 ft^2	0.205	4.881

Note: If the conversion factor for a sheet size is not listed, the ream weight or grammage can be calculated by the following formulas:

- Converting ream weight (lb/500 sheets) to grammage:

$$g/m^2 = \frac{\text{ream weight} \times 1406}{\text{sheet area in square inches}}$$

- Converting grammage to ream weight in lb/500 sheets:

$$\text{lb/ream} = g/m^2 \times \text{sheet area in square inches} \times 0.000711$$

1. If the given trade size is in 480 sheets, then factor should be multiplied by 48/50 (or 0.960).
2. If the given trade size is 480 sheets, then factor should be multiplied by 1.042.

Source: Based on TAPPI Standard T410.

COMPARISON OF ISO AND NORTH AMERICAN PAPER SIZES

ISO sizes			North American sizes		
	Millimeters	Inches		Millimeters	Inches
A0	841 x 1189	$33^{1}/_{8}$ x $46^{3}/_{4}$	NA0	889 x 1143	35 x 45
A1	594 x 841	$23^{3}/_{8}$ x $33^{1}/_{8}$	NA1	559 x 864	22 x 34
A2	420 x 594	$16^{1}/_{2}$ x $23^{3}/_{8}$	NA2	432 x 559	17 x 22
A3	297 x 420	$11^{2}/_{3}$ x $16^{1}/_{2}$	NA3	279 x 432	11 x 17
A4	210 x 297	$8^{1}/_{4}$ x $11^{3}/_{4}$	NA4	216 x 279	$8^{1}/_{2}$ x 11
A5	148 x 210	$5^{7}/_{8}$ x $8^{1}/_{4}$	NA5	139 x 216	$5^{1}/_{2}$ x $8^{1}/_{2}$
A6	105 x 148	$4^{1}/_{8}$ x $5^{7}/_{8}$	NA6	108 x 139	$4^{1}/_{4}$ x $5^{1}/_{2}$

METRIC UNITS FOR WIDELY USED TERMS IN FORESTRY

Term	North American symbol or definition	Suggested metric unit	Equivalent
LAND AREA			
Acre		hectare (ha)	1 acre = 0.4047 ha
Square mile	640 acres	hectare (ha)	1 mi^2 = 259.0 ha
		square kilometer (km^2)	1 mi^2 = 2.59 km^2
Section	640 acres	hectare (ha)	1 section = 259.0 ha
Township	36 square miles (mi^2)	hectare (ha)	1 township = 9324 ha
LUMBER AND BOARD MEASUREMENTS			
Board foot	bdf	cubic meter (m^3)	1 bdf = 0.002360 m^3
1000 board feet	1000 bdf	cubic meter (m^3)	1000 bdf = 2.360 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Square foot	ft^2	square meter (m^2)	1 ft^2 = 0.09290 m^2
Thickness	in.	millimeter (mm)	1 in. = 25.4 mm
WOOD AND PULPWOOD MEASUREMENTS			
Cord	128 ft^3	cubic meter (m^3)	1 cord = 3.624 m^3
Unit	160 ft^3 (wood)	cubic meter (m^3)	1 unit (160 ft^3) = 4.528 m^3
	200 ft^3 (chip)	cubic meter (m^3)	1 unit (200 ft^3) = 5.664 m^3
Cunit	100 ft^3 (solid)	cubic meter (m^3)	1 cunit = 2.832 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Yield/acre	ft^3/acre	cubic meter/hectare (m^3/ha)	1 ft^3/acre = 0.06998 m^3/ha

CONVERSIONS FOR ACCOUNTING

(continued next page)

Unit cost	Multiply by	To obtain
AREA		
\$/acre	2.47105	\$/hectare
\$/square foot	10.7639	\$/square meter
\$/1000 square feet	0.0107639	\$/square meter
	10.7639	\$/1000 square meters
\$/3000 square feet	0.0035879	\$/square meter
ELECTRICAL		
\$/kilowatt-hour	1.0	\$/kilowatt-hour
	0.277778	\$/megajoule
ENERGY		
\$/cubic foot (gas)	35.3147	\$/cubic meter
\$/1000 cubic feet (gas)	35.3147	\$/1000 cubic meters
\$/gallon (U.S.)	(see *Volume*)	
\$/gallon (U.K. liquid)	(see *Volume*)	
FREIGHT		
\$/ton (2000 lb)	(see *Weight*)	\$/metric ton
\$/ton-mile	0.6849	\$/metric ton-kilometer
LABOR		
ton (2000 lb)/man-day	0.9072	metric tons/man-day
\$/ton (2000 lb)	1.10231	\$/metric ton

CONVERSIONS FOR ACCOUNTING

(continued)

Unit cost	Multiply by	To obtain
VOLUME		
$/gallon (U.S.)	0.264173	$/liter
	264.173	$/cubic meter
$/gallon (U.K.)	0.219969	$/liter
	219.969	$/cubic meter
$/1000 gallons (U.S.)	0.264173	$/1000 liters
	0.264173	$/cubic meter
$/million gallons (U.S.)	0.264173	$/1000 cubic meters
$/cubic foot	35.3147	$/cubic meter
$/cubic yard	1.30795	$/cubic meter
WEIGHT (mass)		
$/pound	2.20462	$/kilogram
$/100 pound (CWT)	0.0220462	$/kilogram
$/short ton (2000 lb)	1.10231 (0.9072)	$/metric ton
$/long ton (2240 lb)	0.984206	$/metric ton
WOOD VOLUME		
$/board foot	423.76	$/cubic meter
$/1000 board feet	0.42376	$/cubic meter
$/cubic foot	35.3147	$/cubic meter
$/cord (128 ft^3)	0.2759	$/cubic meter
$/unit (wood)	0.2208	$/cubic meter
$/unit (chip)	0.1766	$/cubic meter
$/cunit (100 ft^3)	0.3531	$/cubic meter

For example, assume the selling price for 42-lb linerboard is \$300/ton. Calculate the price per 1000 m^2:

$$\frac{300 \times 42.0}{2000} = \$6.30/1000\ ft^2;\ \text{thus}$$

$$6.30 \times 10.764 = \$67.81/1000\ m^2$$

Another formula for calculating price on a 1000-square-meter basis is:

$$\$/1000\ m^2 = (\$/\text{metric ton})\ (\text{grammage})\ (0.001)$$

For example, assume that the selling price of linerboard with a grammage of 205 g/m^2 is \$400/metric ton. Calculate the price per 1000 m^2:

$$400 \times 205 \times 0.001 = \$82.00/1000\ m^2$$

SOURCES OF INDUSTRY INFORMATION

Advertisers & Publishers Service Inc.
300 N. Prospect Ave., Park Ridge, Ill. 60068
- SOS/Sources of Supply Buyers Guide (annual)

Allen/Abernethy Publishing Div. of ASM Communications
75 Third St. N.W., Atlanta, Ga. 30365
- American Papermaker (in four regional editions; monthly except bimonthly in October)

American Paper Institute
260 Madison Ave., New York, N.Y. 10016
- Dictionary of Paper (4th edition, 1980)
- Exports of Kraft Linerboard and Corrugating Material (annual)
- Fiber Statistics Subscription Service
- International Report (intermittent)
- Paper, Paperboard, Wood Pulp Capacity (annual)
- Paper, Paperboard & Wood Pulp/Monthly Statistical Summary
- Paper Production Report (weekly)
- Statistics of Paper, Paperboard & Wood Pulp (annual)
- U.S. Exports of Pulp, Paper, Paperboard and Converted Products (annual)
- U.S. Exports of Wastepaper by Destination (annual)
- U.S. Woodpulp Data (monthly)
- Wood Pulp & Fiber Statistics (annual)

American Newspaper Publishers Assn.
Box 17407, Dulles International Airport
Washington, D.C. 20041
- Presstime (monthly)

American Pulpwood Assn.
1619 Massachusetts Ave. N.W.
Washington, D.C. 20036
- Monthly Pulpwood Summary

Arnold Services
106 Runcorn Road, Moore, Warrington WA4 6UB, U.K.
- Yeast from Spent Sulphite Liquor: Manufacture and Marketing

Assn. of Nonwoven Fabrics Industry
1700 Broadway, New York, N.Y. 10019
- International Directory of the Nonwoven Fabrics Industry (biennial)

Benn Publications Ltd.
Sovereign Way, Tonbridge, Kent TN9 1RW, U.K.
- Paper (semi-monthly)

Business Press Inc.
70 Oak St., Norwood, N.J. 07648
- Paper Age (monthly)

Business Trend Analysts
2171 Jericho Turnpike, Commack, N.Y. 11725
- The Corrugated and Paperboard Container Industry: An Analysis of Current Markets and Prospects for Future Growth (1986)
- U.S. Market for Household Paper Products: A Strategic Marketing Analysis and Biennial Review

Canadian Paper Analyst (monthly)
Box 300, Victoria Station
Westmount, Que. H3Z 2V5, Canada

Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada
- Canadian Market Pulp Statistics (monthly)
- Canadian Pulp and Paper Capacity (annual)
- Monthly Newsprint Statistics
- Newsprint Data (annual)
- Reference Tables (annual)
- Statistical Bulletin (monthly)

Central Assn. of Finnish Forest Industries
Eteläesplanadi 2, SF-00130 Helsinki, Finland
- Finnish Forest Industries, 1987

Communication Conseil International
96, rue Montmartre, 75002 Paris, France
- Papercast (monthly)

Data Resources
24 Hartwell Avenue, Lexington, Mass. 02173
- Annual Survey of U.S. Businesses' Plans for New Plants and Equipment (McGraw-Hill Capital Spending Surveys)

Data-Transcripts
Box 14, Dorking, Surrey RH5 4YN, U.K.
- Kraftliner Price Movements vs Supply & Demand Shifts Since 1974
- Specialty Papers and Boards Worldwide Trends & Developments
- Specialty Papers and Products Record (monthly)
- Thermal & Dielectric Papers—Technology, Markets & Company Data

Euro-Data Analysts
Box 13, Dorking, Surrey RH5 4YL, U.K.
- Cost Effective Product Development & Marketing in Paper & Board Mills (1986)

European Paper Institute
42, rue Galilée, F- 75116 Paris, France
- Paper Capacity Report (annual)

Fibre Box Assn.
5725 N. East River Road, Chicago, Ill. 60631
- Fibre Box Industry Annual Report
- Statistical Bulletin/Containerboard Shipments, Consumption, Inventory (monthly)

Food & Agriculture Organization, United Nations
Via della Terme di Caracalla, I- 00100 Rome, Italy
- Estimated Production of Pulp, Paper and Paperboard in Certain Countries (annual)
- Projected Pulp and Paper Mills in the World (annual)
- Pulp and Paper Capacities (annual)

Frost & Sullivan Inc.
106 Fulton St., New York, N.Y. 10038
- Paper Chemicals (1987)

Grade Finders Inc.
Box 944, Exton, Pa. 19341
- Competitive Grade Finder for the Paper and Graphic Arts Industry (annual)

Harcourt Brace Jovanovich Inc.
111 E. Wacker Dr., Chicago, Ill. 60601
- Official Board Markets (weekly)

Harcourt Brace Jovanovich Inc.
120 W. Second St., Duluth, Minn. 55802
- Paper Year Book (annual)
- Paper Sales (monthly)

Harcourt Brace Jovanovich Inc.
7500 Old Oak Blvd., Cleveland, Ohio 44130
- Paperboard Packaging (monthly)

Hatton Brown Publishers
610 S. McDonough St., Montgomery, Ala. 36197
- Paper Industry Equipment (bimonthly)

Hilary House Publishers Inc.
1033 Channel Dr., Hewlett Harbor, N.Y. 11557
- Printing and Graphic Arts Buyers (annual)

Indufor Ky
Kapteeninkatu 14, Box 121, SF-00141, Helsinki, Finland
- Future Prospects of the Soviet Pulp and Paper Industry

International Paper Co.
2 Manhattanville Road, Purchase, N.Y. 10577
- Pocket Pal/Graphic Arts Production Handbook

Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland
- Annual Review of Pulp and Paper Mill Projects Worldwide (annual)
- Monthly Report on Pulp and Paper Mill Projects in the World (11 issues/year)
- Short-term Review of International Pulp & Paper Markets, Worldwide (quarterly)

Japan Paper Assn.
Kami-Parapu Kaikan Bldg., 9-11 Ginza 3-chome
Chuo-ku, Tokyo, Japan
- Pulp & Paper Statistics (annual)

Laves Chemie
Hamburger Allee 12, D-6000 Frankfurt 90, Fed. Rep. Germany
- Carbonless Copy Paper, 1980 through 1990 (5th edition)

Maclean-Hunter Ltd.
777 Bay St., Toronto, Ont. M5W 1A7, Canada
- Pulp and Paper Journal (9 times/year and directory/desk calendar)

Maclean-Hunter Publishing Corp.
300 W. Adams St., Chicago, Ill. 60606
- Boxboard Containers (monthly)
- Paper, Film & Foil Converter (monthly)

Marketing/Technology Service Inc.
4100 South Seventh St., Kalamazoo, Mich. 49009
- North American Fluff Pulp Markets and Prospects for 1986-96

Market News Publishing Corp.
156 Fifth Ave., New York, N.Y. 10010
- Fibre Market News (two times/week)

Merrill Lynch, Pierce, Fenner & Smith Inc.
Securities Research Div.
165 Broadway, New York, N.Y. 10080
- Forest Products and Paper Industry (monthly)

Miller Freeman Publications
500 Howard St.
San Francisco, Calif. 94105
- International Glossary of Technical Terms for the Pulp and Paper Industry (1976)
- Lockwood-Post's Directory of the Pulp and Paper and Allied Trades (annual)
- Map of the European Pulp & Paper Industry (1984)
- Market Pulp Survey
- Mill-by-Mill Listings of Capital Spending Programs (semiannual)
- Nonwovens Markets (25 issues/year)

- Nonwovens World (bimonthly)
- PaperTree Letter (monthly)
- PPI/Capital Investment Service (update on order)
- PPI/International Fact & Price Book (biennial)
- PPI/International Pulp & Paper Directory (biennial)
- PPI/This Week (weekly—48 times/year)
- PPI/Top 150 Companies in the World (annually in September)
- PULP & PAPER (monthly except twice in November)
- PULP & PAPER Buyers Guide (annual)
- Pulp & Paper Dictionary By John R. Lavigne
- PULP & PAPER Forecaster (bimonthly)
- PULP & PAPER INTERNATIONAL (monthly)
- Pulp & Paper Mills in the U.S. & Canada (map, 1988)
- PULP & PAPER Project Report (monthly, with semiannual Mill-by-Mill Listings supplement)
- PULP & PAPER WEEK (weekly—48 times/year)
- Synthetic Polymers and the Paper Industry By Vladimir M. Wolpert

Morgan Stanley, Investment Research
1251 Ave. of the Americas, New York, N.Y. 10020
- Paper Industry Monthly by Thomas P. Clephane and Jeanne Carroll

National Assn. of Recycling Industries Inc.
330 Madison Ave., New York, N.Y. 10017
- Monthly Paper Stock Statistics

National Forest Products Assn.
1250 Connecticut Ave. N.W., Suite 200
Washington, D.C. 20036
- International Trade Report (monthly)

National Paper Trade Assn.
111 Great Neck Road, Great Neck, N.Y. 11021
- Paper Merchant Performance (annual)
- Paper Merchant Sales Report (monthly)
- The Paper Distribution Industry (annual)
- Who's Who in Paper Distribution (annual)

OECD/Organization for Economic Cooperation and Development, Paris, France
OECD Publications Center
1750 Pennsylvania Ave. N.W., Washington, D.C. 20006
- Pulp and Paper/Quarterly Statistics (quarterly)

Pacific Northwest Forest & Range Experiment Station, Forest Service, U.S. Dept. of Agriculture
809 N.E. 6th Ave., Portland, Ore. 97232
- Production, Prices, Employment & Trade in Northwest Forest Industries (quarterly)

PAPIS Ltd.
Collingham House, Gladstone Road
Wimbledon, London SW19 1QH, U.K.
- Pulp Buyers Survey

Pima (Paper Industry Management Assn.)
2400 E. Oakton St., Arlington Heights, Ill. 60005
- Pima (monthly)
- Pima Pulp & Paper Mill Catalog (annual)

Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730
- Paper Packaging Monitor (monthly)
- Paper Trader (monthly)
- World Pulp Monthly

Southam Business Publications
310 Victoria Ave., Westmount, Que. H3Z 2M9, Canada
- Pulp & Paper Canada (monthly)
- Pulp & Paper Canada Annual and Directory (annual)

Statistics Canada
Publications Distribution, User Services Div.
Ottawa, Ont. K1A 0T6, Canada
- Canada: Exports by Commodities and Countries (Catalog 65-004—includes pulp and paper grades; monthly)
- Canada: Imports by Commodities and Countries (Catalog 65-007—includes pulp and paper grades; monthly)
- Pulp and Paper Mills (Catalog No. 36-204—annual)
- Pulpwood and Wood Residue Statistics (Catalog No. 25-001—monthly)

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402
- U.S. Imports, Schedule A, Commodity by Country (Catalog FT135—includes pulp & paper grades; monthly)
- U.S. Exports, Schedule E, Commodity by Country (Catalog FT410—includes pulp & paper grades; monthly)
- 1987 Census of Manufactures

Pulp Mills (SIC 2611)
Paper Mills (SIC 2621)
Paperboard Mills (SIC 2631)
- Current Industrial Reports: Pulp, Paper & Board—M26A (annual)
- U.S. Industrial Outlook

Swedish Pulp and Paper Assn.
Villagatan 1, S-114 32 Stockholm, Sweden
- SCPF Annual Report

TAPPI (Technical Assn. of Pulp & Paper Industry)
15 Technology Park South, Norcross, Ga. 30092
- Tappi Journal (monthly)
- Tappi Journal Directory (annual)

Timber Mart—South Inc.
Box 1278, Highlands, N.C. 28741
- Timber Mart—South (monthly)

University of Wisconsin
432 North Lake St., Madison, Wis. 53706
- Wisconsin Forest Products Price Review (three segments, quarterly or semi-annually)

Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649
- Walden's ABC Guide and Paper Production Yearbook (annual)
- Walden's Fiber & Board Report (semimonthly)
- Walden's Handbook/For Paper Salespeople and Buyers
- Walden's Paper Catalog (2 times a year, in 6 regional editions)
- Walden's Paper Report (twice monthly)

Wood Fibre Northwest (quarterly)
Box 572, Albany, Ore. 97321

SPECIAL REPORTS AND SURVEYS (generally priced at least $1,000)

Andover International Associates
25 Cherry St., Danvers, Mass. 01923
- Outlook for the Uncoated Free Sheet Industry in North America (Supply, Demand and Price Projections) (1987)
- Prospects for Linerboard Manufacture in Non-Traditional Regions (1987)

Celpap Consultants Ltd.
The Runnymede Malt House, Runnymede Road
Egham, Surrey TW20 9BO, U.K.
- CTMP—Technical and Marketing Progress 1985/86 (1987)
- Prospects for CTMP-Containing Papers in the Woodfree Sector (1987)
- Pulp Price Trends (3 vols. per year)

Communication & Information Services
Box 5923, Concord, Calif. 94524
- Series of Data Base Reports on Grades such as Coated, Tissue, Linerboard, SBS, etc.

Corporate Development Consultants Ltd.
Barry House, 20-22 Worple Road
Wimbledon, London SW19 4DH, U.K.
- Containerboard Outlook—Western Europe (1987)
- The European Market for Baby Diapers (1987)
- Labelling in Western Europe (1987)
- Liquid Packaging in the EEC (1987)

The Freedonia Group Inc.
2940 Noble Road, Cleveland, Ohio 44121
- Paper and Pulp to 1995 (#134, 1986)
- Paper vs Plastics (#148) (1986)
- World Paper and Board (#163 1987)

Gorham International Inc.
Box 8, Gorham, Maine 04038
- Carbonless Copy Paper: A Specialized Commodity (1986)
- Coated Woodfree Printing Papers: A Technical Evaluation of European Imports into the North American Market (1987)
- The Dynamic Market Demand for Uncoated Woodfree Printing and Writing Papers (1983)
- Ink Jet Printing: Current Status and Future Prospects (1984)
- Ink Jet Printing Papers (1987)
- Ink Jet Printing: Printing Industry Applications and Impacts (1985)
- Light Weight Coated Printing Papers: A Technical Evaluation of European Imports into the North American Market (1987)
- Release Base Papers: Business Opportunity for Papermakers (1987)
- Thermal Printing Papers—an Evaluation of Business in a Growing Market (1983)
- Wood Free Premium Coated Printing Papers: A Technical Evaluation of European Imports into the North American Market

Indufor Ky
Kapteeninkatu 14, Box 121, SF-00141 Helsinki, Finland
- Pulp and Paper Industry in Eastern Europe (1987)

International Business Forms Industries Inc.
1730 N. Lynn St., Arlington, Va. 22209-2096
- FormsMark I—The Changing Distribution Channels & Marketing Strategies in the Forms Industry
- FormsMark II—The Short-Run Forms Market
- FormsMark III—The Impact of the Intelligent Copier/Printer on the Continuous Forms Market
- FormsMark IV—The Future of Forms in the Banking Industry
- FormsMark V—Opportunities for Forms Manufacturers in the Pressure Sensitive Label Market

Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland
- Fast-Growing Plantations—Impact on the International Market Pulp, Linerboard and Woodfree Paper Businesses
- Financial Performance of Major Forest Product Companies in Western Europe and North America (1986)
- Outlook for World Paper Markets up to 2000
- Paper Machine Reports (to customer specifications)
- Pulp Mill Reports (to customer specifications)

Miller Freeman Publications
500 Howard St.
San Francisco, Calif. 94105
- Ten-Year Outlook—1988 to 1997
- Printing/Writing Papers Outlook—1989 to 1998

Phillip Townsend Associates Inc.
Box 90327, Houston, Texas 77290
- Polyethylene Envelopes: Worldwide Markets and U.S. Technologies 1987-1992 (1988)
- Polyethylene Film Markets and Technologies (1987)
- Outlook for Selected Folding Boxboard Markets 1985-1990-2000 (1985)

Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730
- Timber Inventories in the South: The Availability and Price of Wood Fibre and Stumpage Through 2015 (1986)
- Supercalendered Uncoated Groundwood Paper Markets in North America and Europe (1986)
- Timber Situation in 12 Southern States: Projections for Forest Area, Inventory, Growth, Harvest and Prices Through 2015 (1985)
- U.S. Printing and Writing Paper Study (2 vols.)
- World Kraftliner Study (1987)
- World Market Pulp Study: Outlook for Chemical Paper Grade Market Pulp Through 1995 (1985, 2 vols.)

Strategic Futures Inc.
595 Madison Ave., New York, N.Y. 10022
- Future of Insert/Flyer Marketing and Production through 1990 (2 vols.)

Strategic Research Center
One Commerce Park Square
23200 Chagrin Blvd., Cleveland, Ohio 44122
- Market Update: An Analysis of the Plastic vs Paper Battle (#861, 1986)

COMPANY PROFILES

This section is a listing of U.S. and Canadian companies with daily production capacity of at least 1,000 short tons (U.S.) or 900 metric tpd (Canada), counting facilities for pulp, paper, and paperboard.

Operations are listed under the name of the corporate owner, except when the owner is not in the pulp/paper/board industry. Subsidiaries and joint ventures in the U.S. and Canada are included under the parent firm. Foreign operations are not listed.

Sales and earning figures (when available) are given for 1984 to 1988, and a brief description of each company follows. Pulp and paper/board production sites—with capacity and grades—are also listed. All pulp produced at a millsite, whether shipped as market pulp or consumed onsite in papermaking, is counted.

Financial data:	All sales and earnings figures are shown in U.S. dollars, unless indicated "C$" for Canadian dollars.
Production data:	All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric. To convert to metric tons—multiply by 0.90718. To convert to short tons—multiply by 1.1023.

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Abitibi-Price Inc.

The Exchange Tower, Suite 1300
2 First Canadian Place, Box 39
Toronto, Ont. M5X 1A9
Bernd K. Koken, chairman/president/chief executive officer

[Owned 74.8% by Olympia & York Developments Ltd. Abitibi has two joint ventures: Gaspesia Pulp & Paper Co., subsidiary of Price, 51% (New York Times, 49%); and Augusta Newsprint Co., 50% (Thomson Newspapers Ltd., 50%).]

Net sales:	
1988	C$3,304,500,000
1987	2,988,000,000
1986	2,763,500,000
1985	2,549,800,000
1984	2,137,200,000
Net earnings:	
1988	C$191,100,000
1987	125,700,000
1986	107,300,000
1985	100,200,000
1984	70,100,000

Abitibi-Price is one of the world's leading producers of newsprint and groundwood papers, with annual capacity of 2.44 million metric tons (55% of total revenues). About 90% of total sales result from pulp, paper, paperboard, and converting operations. Company forests provided 47% of woodfiber needs in 1988.

Abitibi-Price's core business is newsprint (nine mills) and groundwood papers (three mills). Provincial Papers is the company's coated paper operation.

Sales in 1988 were: newsprint, C$1,258 million; groundwood papers, $343.1 million; and coated papers, $150.6 million.

Capacity in 1989 was: newsprint, 1,889,000 metric tons; groundwood papers, 447,000 tons; and coated papers, 155,000 tons.

Production in 1988 was: newsprint, 1,900,000 metric tons; groundwood papers, 407,000 tons; and coated paper, 144,000 tons.

The company established a joint venture with Parsons & Whittemore Inc. to build a 220,000-metric-tpy newsprint mill near P&W's Alabama River Pulp Co. bleached kraft market pulp mill at Claiborne, Ala. Upon startup of the US$409-million project in late 1990, Abitibi will probably reclaim its spot as the world's top newsprint producer.

Abitibi is also involved in a partnership with the Venezuelan government, Venezuelan newspaper publishers, and Bowater Inc. to build a 200,000-tpy greenfield newsprint mill that would be completed by late 1992. In August 1989, Abitibi announced a tentative agreement to take over North British Newsprint (Holdings) Ltd.'s plans to build a 205,000-metric-tpy greenfield recycled newsprint mill in Gartcosh, Scotland.

Capital spending during recent years has emphasized expansion into higher-value products through mill modernization and conversion of older machines. Since 1984, major projects have included conversion of the Beaupré, Que., mill from newsprint to groundwood specialties; conversion of Nos. 9 and 10 newsprint machines at Alma, Que., to directory paper; and modernization of the Jonquière, Que., (Kenogami) mill.

Capital expenditures were C$204 million in 1988. Spending was expected to reach $275 million in 1989.

Abitibi owns 1,641 mi^2 of timberlands in Canada and controls another 27,495 mi^2. In the U.S., it owns 134 mi^2 and controls 110 mi^2.

Production facilities:

PINE FALLS, MAN.
Pulp—136 metric tpd sulfite; 408 metric tpd groundwood
Newsprint—465 metric tpd

GRAND FALLS, NFLD.
Pulp—250 metric tpd sulfite; 800 metric tpd thermomechanical
Newsprint—705 metric tpd

STEPHENVILLE, NFLD.
(Stephenville Div.)
Pulp—600 metric tpd thermomechanical
Newsprint—475 metric tpd

GEORGETOWN, ONT.
(Provincial Papers, Port Arthur Div.)
Printing/writing papers—45 metric tpd

IROQUOIS FALLS, ONT.
Pulp—250 metric tpd sulfite; 760 tpd groundwood
Newsprint—825 metric tpd

THUNDER BAY, ONT.
(Provincial Papers)
Pulp—61 metric tpd groundwood
Printing/writing papers—385 metric tpd

THUNDER BAY, ONT.
(Fort William Div.)
Pulp—136 metric tpd sulfite (SCMP); 299 tpd groundwood
Newsprint—385 metric tpd

THUNDER BAY, ONT.
(Thunder Bay Div.)
Pulp—136 metric tpd sulfite; 408 tpd groundwood
Newsprint—455 metric tpd

ALMA, QUE.
Pulp—218 metric tpd sulfite; 708 tpd groundwood
Newsprint—375 metric tpd
Uncoated groundwood—270 metric tpd

BEAUPRÉ, QUE.
Pulp—550 metric tpd chemi-thermomechanical
Uncoated groundwood—400 metric tpd

CHANDLER, QUE.
(Gaspesia Pulp & Paper Co.)
Pulp—408 metric tpd groundwood; 36 tpd refiner mechanical; 250 tpd bleached chemimechanical (BCMP)
Newsprint—650 metric tpd

JONQUIÈRE, QUE.
Pulp—299 metric tpd groundwood; 327 tpd chemi-thermomechanical
Uncoated groundwood—600 metric tpd

LaCHUTE, QUE.
(Price Wilson)
Packaging, toweling paper—21 metric tpd

AUGUSTA, GA.
(Augusta Newsprint Co.)
Pulp—496 short tpd (450 metric) groundwood; 772 short tpd (700 metric) thermomechanical
Newsprint—1,075 short tpd (975 metric)

Total production capacity:

PULP	
Groundwood	3,801 metric tpd
SCMP	136 metric tpd
BCMP	250 metric tpd
Refiner mechanical	36 metric tpd
Sulfite	990 metric tpd
CTMP	877 metric tpd
TMP	2,100 metric tpd
Total	8,190 metric tpd
PAPER	
Newsprint	5,310 metric tpd
Groundwood	1,270 metric tpd
Printing/writing	430 metric tpd
Packaging/toweling	21 metric tpd
Total	7,031 metric tpd

Appleton Papers Inc.

825 E. Wisconsin Ave.
Box 359
Appleton, Wis. 54912
Gordon Bond, chairman/chief executive officer

(Subsidiary and paper division of BATUS Inc. of U.S., in turn a subsidiary of B.A.T Industries plc of U.K.)

Net sales:	
1988	$844,076,000
1987	779,312,000
1986	723,211,000
1985	639,139,000
1984	572,712,000
Operating income:	
1988	$131,072,000
1987	126,317,000
1986	134,342,000
1985	112,144,000
1984	105,358,000

Appleton is the world's leading producer of carbonless copy paper. It also produces thermal-grade paper, high-quality graphic arts products, and specialty coated papers. The company has converting/coating/finishing plants, capsular plants, and a chemical plant.

Although carbonless paper has long been Appleton's bread and butter, the company announced in early 1989 that it would establish a business unit dedicated solely to thermal paper. This area of Appleton's business is thriving with the proliferation of facsimile machines and bar-coded pressure-sensitive labels. In 1988, the company added a thermal paper coating machine at its finishing plant in Appleton, Wis., which more than doubled company-wide thermal paper capacity

Since acquiring the West Carrollton mill in 1984, Appleton has rebuilt all three of its paper machines and dedicated them solely to producing carbonless paper. The company has the same agenda in mind for its two other mills during 1990-91. Two of three paper machines at Roaring Spring and two of four paper machines at Combined Locks are slated for rebuilds.

Capital expenditures were $52.2 million in 1988.

Production facilities:

WEST CARROLLTON, OHIO
(West Carrollton mill)
Pulp—180 tpd bleached deinked
Carbonless paper—350 tpd

ROARING SPRING, PA.
(Spring mill)
Pulp—250 tpd bleached kraft
Carbonless paper—273 tpd

COMBINED LOCKS, WIS.
(Locks mill)
Pulp—200 tpd chemimechanical
Carbonless paper—530 tpd

Total production capacity:

PULP	
Kraft	250 tpd
Chemimechanical	200 tpd
Deinked	180 tpd
Total	630 tpd
PAPER	1,153 tpd

Boise Cascade Corp.

One Jefferson Sq.
Boise, Idaho 83728
John B. Fery, chairman/chief executive officer

(Boise owns Boise Cascade Canada.)

Net sales:	
1988	$4,094,630,000
1987	3,820,810,000
1986	3,739,970,000
1985	3,737,220,000
1984	3,816,850,000
Net income:	
1988	$289,120,000
1987	182,990,000
1986	101,540,000
1985	104,290,000
1984	69,610,000

A company-wide restructuring program that began in 1980 has led Boise Cascade to concentrate on its paper, corrugated container, office products distribution, and building products businesses. Within the paper segment, Boise has been positioning itself over the last 15 years in communications papers, primarily business papers made from uncoated free-sheet and publication papers such as coated white papers, uncoated groundwood, and newsprint.

Operating income for paper and paper products was $517 million in 1988. Paper sales volume for both years was about 3.3 million tons, equivalent to a 99% operating rate. Total paper and paper product sales in 1988 were $2.5 billion.

Boise closed its specialty paperboard mill at Brownville, N.Y., in 1988. In June 1988, the company announced a $525-million expansion and modernization program at International Falls, Minn., including installation of a 210,000-tpy uncoated free-sheet machine. Boise also plans to rebuild and modify two coated paper machines at Rumford, Maine. This project will add about 45,000 tpy of capacity by late 1990.

The company's capital expenditures totaled over $3.9 billion during the 1978-88 period. Of the $452 million spent in 1988, about $346 million went to the paper and paper products segment. Boise earmarked $700 million for capital spending in 1989.

Boise owns in fee 2.9 million acres of timberland, and it controls about 3.4 million more through long-term leases, contracts, and licenses.

Production facilities:

White Paper Div.

JACKSON, ALA.
(Former Allied Paper Co. mill)
Pulp—600 tpd bleached kraft (360 for market)
Uncoated free-sheet—250 tpd

INTERNATIONAL FALLS, MINN.
Pulp—400 tpd bleached kraft
Uncoated free-sheet—580 tpd

ST. HELENS, ORE.
Pulp—925 tpd bleached kraft
Uncoated free-sheet—600 tpd

VANCOUVER, WASH.
Uncoated free-sheet—290 tpd

WALLULA, WASH.
Pulp—820 tpd bleached kraft (300 tpd for market); 180 tpd semichemical
Uncoated free-sheet—570 tpd
Containerboard—305 tpd

Coated & Specialty Converting Paper Div.

RUMFORD, MAINE
Pulp—840 tpd bleached kraft; 170 tpd groundwood; 165 tpd thermomechanical
Coated paper—1,130 tpd
Uncoated free-sheet—335 tpd

Publishing & Packaging Paper

DeRIDDER, LA.
(Boise Southern Co.)
Pulp—1,115 tpd unbleached kraft; 270 tpd bleached kraft; 375 tpd groundwood; 390 tpd thermomechanical
Newsprint—1,000 tpd
Containerboard—1,160 tpd

STEILACOOM, WASH.
Pulp—475 tpd thermomechanical
Newsprint—540 tpd

FORT FRANCES, ONT.
(Boise Cascade Canada)
Pulp—470 metric tpd (520 short) groundwood; 530 metric tpd (585 short) bleached kraft (340 tpd for market)
Uncoated groundwood papers—690 metric tpd (765 short)

KENORA, ONT.
(Boise Cascade Canada)
Pulp—545 metric tpd (600 short) groundwood; 245 metric tpd (270 short) sulfite
Newsprint—835 metric tpd (920 short)

Specialty Paperboard Div.

BEAVER FALLS, N.Y.
Specialty paperboard—55 tpd

BRATTLEBORO, VT.
Specialty paperboard—85 tpd

SHELDON SPRINGS, VT.
Pulp—50 tpd groundwood
Specialty paperboard—140 tpd

Total production capacity:

PULP (short tons)	
Kraft	5,555 tpd
Groundwood	1,715 tpd
TMP	1,030 tpd
Sulfite	270 tpd
Semichemical	180 tpd
Total	8,750 tpd

PAPER AND BOARD (short tons)	
Uncoated free-sheet	2,625 tpd
Newsprint	2,460 tpd
Coated	1,130 tpd
Uncoated groundwood	765 tpd
Containerboard	1,465 tpd
Specialty paperboard	280 tpd
Total	8,725 tpd

Bowater Inc.

One Parklands Drive, Box 4012
Darien, Conn. 06820-4012
Anthony P. Gammie,
chairman/president/chief executive officer

[Bowater owns 51% of Catawba Newsprint Co. (Newhouse Newspaper Group, 49%) and 51% of Mersey Paper Co. Ltd. (The Washington Post, 49%).]

Net sales:	
1988	$1,410,411,000
1987	1,231,002,000
1986	919,690,000
1985	904,004,000
1984	887,855,000

Net income:	
1988	$164,317,000
1987	81,140,000
1986	49,444,000
1985	67,520,000
1984	72,098,000

Spun off by its English parent as an independent company in 1984, Bowater is a major producer of newsprint (about 75% of its capacity), coated publication paper, and market pulp. It is the largest U.S. manufacturer of newsprint and the third largest in North America. Bowater has diversified into the forms business, and in 1987 it doubled operations through the acquisition of Star Forms Inc.

Sales in 1988 were $671 million for newsprint, $270 million for coated paper, $153 million for market pulp, and $279 million for computer forms.

Production in 1988 was 1,241,000 short tons of newsprint, 338,000 tons of coated paper, and 251,000 tons of market pulp.

Capital expenditures in 1988 were 214.3 million. The company planned to spend $360 million in 1989.

Bowater is involved in a partnership with the Venezuelan government, Venezuelan newspaper publishers, and Abitibi-Price Inc. to build a 200,000-tpy greenfield newsprint mill that would be completed by late 1992.

In 1988, Bowater Southern broke ground for a $205-million, 320,000-tpy bleached kraft pulp mill to replace the existing unit at Calhoun, Tenn. Besides supplying pulp to the newsprint machines, it will be capable of producing 80,000 tpy of market pulp. Startup is scheduled for late 1989.

In early 1988, Bowater Mersey began an expansion at its 250,000-metric-tpy newsprint mill at Liverpool (Brooklyn), N.S. Capacity will increase by 50,000 tpy, and the mill will be converted to 100% thermomechanical pulp. The C$100-million project will be completed by late 1989.

Bowater owns or leases over 1.8 million acres of timber.

Production facilities:

CATAWBA, S.C.
(Bowater Carolina Co.)
Pulp—1,050 tpd bleached kraft (700 tpd for market); 120 tpd thermomechanical; 90 tpd groundwood
Coated publication paper—365 tpd

CATAWBA, S.C.
(Catawba Newsprint Co.)
Pulp—544 tpd thermomechanical
Newsprint—680 tpd

CALHOUN, TENN.
(Bowater Southern Paper Co.)
Pulp—690 tpd semibleached kraft; 900 tpd groundwood; 220 tpd chemimechanical; 1,000 tpd thermomechanical
Newsprint—2,150 tpd

LIVERPOOL (Brooklyn), N.S.
(Bowater Mersey Paper Co.)
Pulp—345 metric tpd (380 short) groundwood; 181 metric tpd (200 short) thermomechanical; 163 metric tpd (180 short) sulfite
Newsprint—608 metric tpd (670 short)

Total production capacity:

PULP (short tons)	
Chemimechanical	220 tpd
Kraft	1,740 tpd
Groundwood	1,370 tpd
Sulfite	180 tpd
TMP	1,864 tpd
Total	5,374 tpd

PAPER (short tons)	
Publication	365 tpd
Newsprint	3,500 tpd
Total	3,865 tpd

Brant-Allen Industries Inc.

(Formerly Bato Co. Inc.)
80 Field Point Road
Greenwich, Conn. 06830
Peter M. Brant, chief executive officer

[F.F. Soucy Inc. is a wholly owned subsidiary. Brant-Allen owns 50% of F.F. Soucy Inc. et Associés (Dow Jones owns 40% and Rexfor 10%). Brant-Allen is joint owner of Bear Island Paper with Dow Jones and Washington Post.]

Financial data not available.

Brant-Allen, an integrated manufacturer, produced 394,000 short tons of newsprint in 1988.

Capital expenditures in 1988 were $12 million, and $13 million was budgeted for 1989.

The company owns 235,000 acres of timberlands in U.S.

Production facilities:

ASHLAND, VA.
(Bear Island Paper Co.)
Pulp—625 tpd thermomechanical
Newsprint—580 tpd

RIVIÈRE-du-LOUP, QUE.
(F.F. Soucy Inc.)
Pulp—490 metric tpd (540 short) thermomechanical
Newsprint—151 metric tpd (166 short)

RIVIÈRE-du-LOUP, QUE.
(F.F. Soucy Inc. et Associés)
Newsprint—364 metric tpd (401 short)

Total production capacity:

PULP (short tons)	
TMP	1,165 tpd

PAPER (short tons)	
Newsprint	1,147 tpd

Canadian Pacific Forest Products Ltd.

1155 Metcalfe St.
Montreal, Que. H3B 2X1
Cecil S. Flenniken, chairman/president/chief executive officer

Net sales:	
1988	C$3,005,900,000
1987	2,764,700,000
1986	2,316,700,000
Net earnings:	
1988	C$323,400,000
1987	214,000,000
1986	33,300,000

Canadian Pacific Forest Products Ltd. was formed in April 1988 by a merger of CIP Inc. and Great Lakes Forest Products Ltd. At the time, Canadian Pacific Ltd. wholly owned CIP and held 54.3% of Great Lakes, giving it 79.7% ownership of the new company.

CPFP is one of the world's largest integrated forest products companies, covering newsprint and groundwood specialties, pulp, paperboard and packaging, white paper, tissue products, and lumber. The company is the world's second largest producer of newsprint. In pulp production, it ranks first in Canada, second in North America, and fourth in the world. CPFP also operates 13 converting plants and five sawmills in Canada.

At the end of 1988, the company's sales exceeded C$3 billion, and total assets were $2.7 billion. About 88% of sales came from pulp, paper, and paperboard products.

In 1988, production of paper and paperboard products was 2,056,923 metric tons. Pulp production was 1,025,770 tons.

Capital expenditures in 1988 were C$237.2 million. The company planned to spend $637.4 million in 1989, 90% of that amount on pulp and papermaking facilities.

CPFP's largest expansion project currently underway is the C$350-million modernization program at Thunder Bay, Ont. A 245,000-metric-tpy thermomechanical pulp mill will replace a groundwood pulp mill, and a 240,000-metric-tpy high-speed newsprint machine will replace two older machines for a net capacity gain of 60,000 tpy. Startups are scheduled for 1990-91.

A 175,000-metric-tpy white paper machine was scheduled for startup at Dryden, Ont., in mid-1989.

The Gold River (B.C.) and Ponderay (Usk, Wash.) newsprint mills are joint ventures with partners mainly from the publishing industry. CPFP's equity commitment is C$78 million on a total cost of C$323 million for Gold River and US$44 million (C$55 million) on a total cost of US$300 million for Ponderay. Both mills were scheduled to start up in 1989.

With 100,000 km^2 of forests, CPFP is the largest holder of timber-cutting rights in Ontario and a major forest landowner in British Columbia, Quebec, and New Brunswick.

Production facilities:

GOLD RIVER, B.C.
Pulp—710 metric tpd kraft (for market)
(Gold River Newsprint Ltd Partnership)
Newsprint—640 metric tpd (1989 startup)

DALHOUSIE, N.B.
(NBIP Forest Products Inc.)
Pulp—570 metric tpd stone groundwood; 410 metric tpd SCMP
Newsprint—940 metric tpd

DRYDEN, ONT.
Pulp—790 metric tpd bleached and unbleached kraft (360 tpd for market)
White paper—310 metric tpd (800 tpd in 1990)

TORONTO, ONT.
(Dominion Cellulose Ltd.)
Tissue paper—230 metric tpd

GATINEAU, QUE.
Pulp—625 metric tpd stone groundwood; 450 metric tpd refiner groundwood; 375 metric tpd chemimechanical
Newsprint—1,570 metric tpd

LA TUQUE, QUE.
Pulp—1,450 metric tpd kraft (440 tpd for market)
Kraft paperboard—635 metric tpd
Solid bleached board—240 metric tpd

MATANE, QUE.
Pulp—250 metric tpd semichemical
Semichemical corrugating medium—270 metric tpd

THUNDER BAY, ONT.
Pulp—1,335 metric tpd bleached kraft (for market); 300 metric tpd high-yield sulfite; 910 metric tpd groundwood
Newsprint—1,160 metric tpd

TROIS RIVIÈRES, QUE.
Pulp—255 metric tpd sulfite; 680 metric tpd groundwood
Groundwood specialties—920 metric tpd

USK, WASH.
(Ponderay Newsprint Co.)
Newsprint—500 metric tpd (1989 startup)

Total production capacity:

PULP	
Kraft	4,285 metric tpd
Groundwood	3,235 metric tpd
SCMP	410 metric tpd
Chemimechanical	375 metric tpd
Semichemical	250 metric tpd
Sulfite	555 metric tpd
Total	9,110 metric tpd

PAPER AND BOARD	
Newsprint	3,670 metric tpd*
Groundwood specialties	920 metric tpd
Tissue paper	230 metric tpd
White paper	310 metric tpd (not including 1990 expansion)
Unbleached board	635 metric tpd
Solid bleached board	240 metric tpd
Corrugating medium	270 metric tpd
Total	6,275 metric tpd*

* = Does not include Gold River, B.C., and Usk, Wash., newsprint mills.

Canfor Corp.

2800—1055 Dunsmuir St.
P.O. Box 49420, Bentall Postal Station
Vancouver, B.C. V7X 1B5
Peter J.G. Bentley, chairman/chief executive officer

(Canadian Forest Products Ltd. is a wholly owned subsidiary. Howe Sound Pulp & Paper Ltd. is a 50%-owned affiliate.)

Net sales:	
1988	C$1,084,200,000
1987	1,244,900,000
1986	1,046,766,000
1985	1,083,799,000
1984	1,029,500,000
Net earnings:	
1988	C$[illegible]30,000,000
1987	102,700,000
1986	23,785,000
1985	–61,454,000
1984	–23,800,000
Net sales, pulp and paper:	
1988	C$414,500,000
1987	480,700,000
1986	320,000,000
1985	254,000,000
1984	262,000,000

Canfor is one of Canada's largest producers of market pulp and lumber. The company returned to profitability in 1986 after four years of heavy losses (totaling C$213 million) due to weak markets. In 1985, it bought the shares of Intercontinental Pulp that it did not already own. The company sold interests in several wood products, financial, and diversified manufacturing companies to reduce debt.

In late 1987, Canfor and Oji Paper Co. Ltd. of Japan announced plans to establish a new company to acquire the Howe Sound Pulp Div. at Port Mellon, B.C., plus a sawmill and chipping plant. The new company, Howe Sound Pulp & Paper Ltd., is a 50-50 joint enterprise. A C$1-billion expansion and modernization project will bring its capacity for market pulp to 1,000 metric tpd by 1990. A 585-metric-tpd newsprint machine will be added by 1991.

Canfor pulp and paper sales reached C$414.5 million in 1988, which was 38% of total sales.

Canfor produced 454,900 metric tons of pulp in 1988. (This figure does not include production of Howe Sound Pulp & Paper Ltd.) Canfor also produced 100,500 metric tons of kraft paper.

Capital expenditures in 1988 were C$107.8 million, up from C$57.9 million in 1987. The company planned to spend over $100 million during 1989. Pulp and papermaking facilities, excluding Howe Sound Pulp & Paper Ltd., account for 35% of capital spending.

Canfor owns or controls 620,000 hectares of timber.

Production facilities:

PORT MELLON, B.C.
(Howe Sound Pulp & Paper Ltd., formerly Howe Sound Pulp Div.)
Pulp—665 metric tpd bleached kraft (for market)

PRINCE GEORGE, B.C.
(Intercontinental Pulp)
Pulp—685 metric tpd bleached and unbleached kraft (for market)

PRINCE GEORGE, B.C.
(Prince George Pulp & Paper)
Pulp—500 metric tpd bleached and unbleached kraft (for market)
Sack paper—295 metric tpd

Total production capacity:

PULP	
Market	1,185 metric tpd (1,850 metric tpd, including Howe Sound Pulp & Paper Ltd.)
PAPER	
Sack	295 metric tpd

Caraustar Industries Inc.

Washington St., Box 115
Austell, Ga. 30001
James G. Dalton, chairman/chief executive officer

(Settsu Corp., Japan's leading producer of recycled paperboard, has a 24% minority interest in Caraustar.)

Financial data not available.

Caraustar is a privately owned holding company that has recycled paperboard mills and converting plants. It is the fourth-largest U.S. producer of recycled paperboard, with a total capacity of about 525,000 tpy. It has ten mills in the Southeast and Midwest, 16 paper tube and core plants, four setup folding carton plants, and seven wastepaper baling plants. Its most recent purchase was a 130-tpd gypsum liner mill in Camden, N.J., which it bought from USG Corp. in September 1988. This complements Caraustar's gypsum liner mills in Austell, Ga., and in Cincinnati, Ohio.

Production facilities:

AUSTELL, GA.
(Austell Box Board Corp.)
Recycled paperboard—425 tpd

AUSTELL, GA.
(Sweetwater Paper Board Co.)
Recycled paperboard—375 tpd

CAMDEN, N.J.
(former USG Corp. mill)
Gypsum board—130 tpd

CHICAGO, ILL.
(Chicago Paperboard Corp.)
Recycled paperboard—200 tpd

CHARLOTTE, N.C.
(Carolina Paper Board Corp.)
Recycled paperboard—150 tpd

CINCINNATI, OHIO
(Cincinnati Paperboard Corp.)
Recycled paperboard—200 tpd

SINKING SPRING, PA.
(Reading Paper Board Corp.)
Recycled paperboard—47 tpd

TAYLORS, S.C.
(Carotell Paper Board Corp.)
Recycled paperboard—185 tpd

CHATTANOOGA, TENN.
(Chattanooga Paperboard Corp.)
Recycled paperboard—150 tpd

Total production capacity:

PAPERBOARD	1,862 tpd

Cascades Inc.

404 Marie-Victorin St.
Box 30
Kingsey Falls, Que. J0A 1B0
Bernard Lemaire, president

Net sales:	
1988	C$588,792,000
1987	527,732,000
1986	440,130,000
1985	266,272,000
1984	179,651,000
Net earnings:	
1988	C$39,139,000
1987	34,148,000
1986	33,777,000
1985	19,443,000
1984	12,667,000

Founded in 1964, Cascades has grown rapidly through a series of acquisitions in eastern Canada, the U.S., and France. The company is controlled by the Lemaire family of Quebec, which originally started in the wastepaper business. The company's product line includes pulp and kraft paper, toilet paper and paper towels, corrugating medium, boxboard, egg trays, roofing insulating paper, health and hygiene products, and plastics. It is the first established North American paper company to pitch its hygiene products as "environmentally friendly." Cascades has 12 mills in North America plus five mills in Europe.

The company recently completed a

C$45-million project at its mill in Jonquière, Que., in which an eight-cylinder machine was upgraded into a three-fourdrinier unit, the first of its kind in North America. This doubled boxboard capacity to about 125,000 tpy, and it improved board quality.

In a 50-50 joint venture, Rexfor and Cascades acquired the closed Port-Cartier, Que., mill from ITT Rayonier Inc. in 1986. With the help of government funds, the mill was converted from sulfite pulp to bleached chemi-thermomechanical pulp by 1988. It now has capacity for about 180,000 metric tpy of BCTMP.

Cascades is the only company in North America that can produce large amounts of BCTMP fluff pulp in rolls—something increasingly sought by diaper makers. About 80% of the pulp is sold to the U.K., France, and Fed. Rep. Germany.

Some of that BCTMP fluff pulp will supply a new C$30-million, 80-metric-tpd tissue machine that started up at Cascades Ltee. division in Kingsey Falls, Que., in fourth-quarter 1989. (Cascades owns 50% of this division; Wyant Ltd. owns the other half.) Cascades is marketing the tissue as "environmentally friendly" because it will not contain chlorine-bleached pulp. The company will also sell diapers and sanitary napkins made from BCTMP.

Cascades may add a 125,000-metric-tpy CTMP mill at the site of its semichemical medium mill in Cabano, Que. (It increased its share in the mill to 95% when it bought 30% from Rexfor in spring 1987.) This project would cost C$130 million, and it would provide pulp for Rolland Inc.'s printing/writing paper mills. Cascades has a 34% stake in Rolland, which it says it will sell for the right price. Cascades was unsuccessful in its attempt to buy out Rolland.

In mid-1989, Cascades announced it would spend C$50 million to modernize its recycled folding boxboard mill at East Angus, Que. The first phase of the project was scheduled to be completed in fall 1990.

Production facilities:

BRANTFORD, ONT.
(Cascades Dominion Inc., former Reid Dominion Packaging Ltd. mill)
Molded pulp products—egg cartons

BREAKEYVILLE, QUE.
(Désencrage Cascades Inc.)
Pulp—91 metric tpd deinked (for market)

CABANO, QUE.
(Papier Cascades [Cabano] Inc.)
Pulp—250 metric tpd semichemical
Corrugating medium—272 metric tpd

EAST ANGUS, QUE.
(Cascades [East-Angus] Inc.)
Pulp—181 metric tpd unbleached kraft; 109 metric tpd semichemical
Kraft wrapping paper—220 metric tpd
Folding boxboard—100 metric tpd

JOLIETTE, QUE.
(Cascades [Joliette] Inc.)
Sheathing, indenting paper—64 metric tpd

JONQUIÈRE, QUE.
(Cascades [Jonquière] Inc.)
Pulp—200 metric tpd bleached and unbleached kraft (60 tpd for market); 100 metric tpd thermomechanical
Boxboard—352 metric tpd

KINGSEY-FALLS, QUE.
(Cascades Paper Inc.)
Corrugating medium—77 metric tpd
Molded pulp products—32 metric tpd

KINGSEY-FALLS, QUE.
(Les Industries Cascades Ltee.)
Tissue—210 metric tpd
Toweling—77 metric tpd

KINGSEY-FALLS, QUE.
(Papier Kingsey-Falls)
Asbestos paper—118 metric tpd

PORT-CARTIER, QUE.
(Cascades [Port-Cartier] Inc.)
Pulp—500 metric tpd bleached chemi-thermomechanical

NIAGARA FALLS, N.Y.
(Cascades Niagara Falls Inc.—former Nitec Paper Corp. mill)
Corrugating medium—250 short tpd (226 metric)

ROCKINGHAM, N.C.
(Cascades Industries Inc.)
Tissue—60 short tpd (54 metric)

Total production capacity:

PULP	
Kraft	381 metric tpd
Semichemical	359 metric tpd
TMP, BCTMP	600 metric tpd
Deinked	91 metric tpd
Total	1,431 metric tpd
PAPER AND BOARD	
Tissue/toweling	261 metric tpd
Kraft packaging	240 metric tpd
Corrugating medium	530 metric tpd
Boxboard	507 metric tpd
Industrial paper/board	182 metric tpd
Total	1,720 metric tpd

Champion International Corp.

One Champion Plaza
Stamford, Conn. 06921
Andrew C. Sigler, chairman/chief executive officer

(Champion owns 84.6% of Weldwood of Canada Ltd., which in turn owns 50% of Cariboo Pulp & Paper Co.; Daishowa-Marubeni International Ltd. owns the other 50%.)

Net sales:	
1988	$5,128,513,000
1987	4,614,723,000
1986	4,387,623,000
1985	5,769,759,000
1984	5,121,089,000
Net income:	
1988	$456,445,000
1987*	382,012,000
1986	200,832,000
1985**	163,139,000
1984***	139,032,000

* Includes $88.7-million net gain from sale of assets.

** Excludes $5-million gain from St. Regis acquisition.

*** Excludes after-tax write-off of $150 million for restructure of building products plants and timber contract expected losses. Excludes 60% of St. Regis for October and November and 100% for December.

Champion International is emphasizing growth in the printing/writing grades following the sale of all but one of its unbleached kraft packaging mills. Its merger with St. Regis Paper Co. focused Champion on being primarily a pulp and paper company and combined Champion's strength in coated and uncoated free-sheet grades with St. Regis' strength in uncoated groundwood grades, lightweight coated publication papers, and newsprint.

Since the merger, however, several mills have been sold: Battle Creek, Mich., and St. Paul, Minn., to Waldorf Corp.; Ontonagon, Mich., Missoula, Mont., and York, Pa., to Stone Container Corp.; Pasadena, Texas, and Tacoma, Wash., to Simpson Paper Co.; Little Falls, Minn., to Carlyle Investment Corp.; and Columbus, Ohio, to Du Pont Co.'s Industrial Imaging Systems Div.

In early 1988, Weldwood of Canada Ltd. got approval from shareholders to purchase Champion's St. Regis Paper Co. (Canada) Ltd., which includes Champion Forest Products (Alberta) Ltd. (of which the Hinton, Alta., market pulp mill is a part) and St. Regis Resources Ltd. (oil and gas). In exchange, Champion's share in Weldwood was boosted from 71.8% to 84.6%.

Net sales of paper in 1988 were $4.0

billion, constituting 74% of total company sales. Printing/writing papers accounted for 48% of paper sales, lightweight publication papers 18%, and newsprint 10%.

Champion's paper division produced 3,509,425 short tons of paper and board in 1988. Champion also produced 3,130,867 tons of pulp, while Weldwood of Canada produced 363,400 tons. U.S. packaging operations produced 425,100 tons of paper/paperboard and 414,600 tons of pulp.

Otner 1988 production figures: 296,000 short tons of coated paper, 1,076,000 tons of uncoated paper, 670,000 tons of publication papers, and 848,000 tons of newsprint.

The company devoted $626 million to capital expenditures in 1988, and it expected to spend $850 million in 1989.

A C$360-million pulp expansion project at Weldwood's Hinton, Alta., mill is scheduled for completion in 1990. In August 1988, Champion began construction of a 265,000-tpy coated free-sheet paper machine at Quinnesec, Mich., which will use about half the mill's pulp output. The addition will cost $355 million, and startup is scheduled for summer 1990. A $475-million series of projects is planned for the printing/writing papers mill at Courtland, Ala. Pulp capacity will increase by 241,000 tpy, half of which will be used by company mills or sold as market pulp. Paper capacity at the mill will increase by 140,000 tpy.

Champion owns or controls 6,444 acres of timberland in the U.S. In Canada, the company has cutting rights on 2,488,000 acres in Alberta, and Weldwood owns 42,000 acres and holds a pulpwood harvesting license on 3.9 million acres.

Production facilities:

COURTLAND, ALA.
(Paper Div.)
Pulp—1,525 tpd kraft
Uncoated and coated printing/writing and converting paper—1,760 tpd

PENSACOLA (Cantonment), FLA.
(Printing & Writing Div.)
Pulp—1,300 tpd bleached kraft
Uncoated free-sheet paper—754 tpd
Kraft paper—292 tpd

BUCKSPORT, MAINE
(Publication Papers)
Pulp—299 tpd groundwood; 150 tpd thermomechanical
Publication papers—1,140 tpd

QUINNESEC, MICH.
Pulp—750 bleached hardwood kraft (for market)

SARTELL, MINN
(Publication Papers)
Pulp—424 tpd thermomechanical
Publication papers—810 tpd (546 tpd coated, 264 tpd uncoated)

DEFERIET, N.Y.
(Publication Papers)
Pulp—331 tpd groundwood
Publication papers—614 tpd

CANTON, N.C.
(Paper Div.)
Pulp—1,445 tpd bleached kraft
Uncoated printing/writing and converting paper—895 tpd
Bleached paperboard—715 tpd

ROANOKE RAPIDS, N.C.
(Packaging Div.)
Pulp—1,300 tpd unbleached kraft
Unbleached kraft paper—525 tpd
Unbleached linerboard—750 tpd

HAMILTON, OHIO
(Paper Div.)
Uncoated and coated printing/writing and converting paper—523 tpd

HOUSTON, TEXAS
(Newsprint Div., Sheldon mill)
Pulp—650 tpd kraft (unbleached 300 tpd, bleached 350 tpd); 800 tpd groundwood; 400 tpd thermomechanical
Newsprint—1,220 tpd

LUFKIN, TEXAS
(Newsprint Div., Lufkin Mill)
Pulp—400 tpd unbleached kraft (360 tpd semibleached); 830 tpd groundwood
Newsprint—980 tpd
Directory paper—150 tpd

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.—See Daishowa America Co. and Weldwood of Canada Ltd.)

Total production capacity:

PULP (short tons)	
Kraft	7,370 tpd
Groundwood	2,260 tpd
TMP	974 tpd
Total	10,604 tpd

PAPER (short tons)	
Newsprint	2,200 tpd
Printing/writing and converting	3,178 tpd
Publication papers	2,564
Uncoated free-sheet	754 tpd
Directory	150 tpd
Kraft	817 tpd
Total	9,663 tpd

PAPERBOARD (short tons)	
Bleached	715 tpd
Linerboard	750 tpd
Total	1,465 tpd
TOTAL PAPER/BOARD	11,128 tpd

Chesapeake Corp.

1021 E. Cary Street, Box 2350
Richmond, Va. 23218-2350
J. Carter Fox, president/chief executive officer

Net sales:	
1988	$711,300,000
1987	675,713,000
1986	599,770,000
1985	449,500,000
1984	347,700,000
Net income:	
1988	$51,500,000
1987	30,153,000
1986	13,738,000
1985	15,694,000
1984	22,133,000

From only one mill at West Point, Va., Chesapeake underwent a dramatic change in 1985 with its $210-million purchase of Wisconsin Tissue Mills Inc. and Plainwell Paper Co. from Philip Morris Inc. This extended its original product line of linerboard, kraft paper, and hardwood market pulp to include commercial/industrial tissue and coated and uncoated specialty and premium printing papers. In late 1987, Chesapeake sold Plainwell to Simpson Paper Co., eliminating printing and special industrial papers from its line. The company currently focuses on kraft and tissue products, packaging, and treated wood.

Paper sales in 1988 were $418.5 million, which was 59% of total sales. Chesapeake shipped 646,000 tons of kraft products and 131,000 tons of tissue products.

Capital expenditures in 1988 were $72.2 million, almost double the amount spent in 1987. The company expected to spend $145 million in 1989.

In 1988, Chesapeake began a $160-million expansion at Wisconsin Tissue Mills with expenditures for distribution facilities and converting equipment. An 80,000-tpy tissue machine will be added by mid-1990, raising mill capacity to about 200,000 tpy.

Chesapeake owns 356,000 acres of timberland.

Production facilities:

WEST POINT, VA.
Pulp—1,400 tpd softwood and hardwood kraft (450 tpd bleached for market)
Paper—320 tpd
Paperboard—1,430 tpd

MENASHA, WIS.
(Wisconsin Tissue Mills Inc.)
Pulp—deinking
Paper—300 tpd tissue

Total production capacity:

PULP	1,400 tpd
PAPER AND BOARD	2,050 tpd

Consolidated-Bathurst Inc.

800 René-Lévesque Blvd. West
Montreal, Que. H3B 1Y9
T.O. Stangeland, chairman/chief executive officer

(Consolidated-Bathurst was acquired by Stone Container Corp. for C$2.6 billion in March 1989. Con-Bath was renamed Stone Consolidated Inc. on Sept. 1, 1989, and it was given a world product mandate over production and marketing of both companies' newsprint, groundwood specialties, and market pulp operations. The merger creates the second-largest pulp, paper, and paperboard producer in the world, with estimated sales of more than US$6 billion and capacity of approximately 7.5 million short tpy. The listing below covers only Con-Bath and its fiscal year 1988.)

Net sales:	
1988	C$2,372,083,000
1987	2,261,430,000
1986	2,017,834,000
1985	1,727,468,000
1984	1,622,984,000
Net earnings:	
1988	C$239,630,000
1987	214,415,000
1986	49,417,000
1985	77,564,000
1984	58,901,000

Con-Bath is a forest products and packaging organization with three business sectors: pulp and paper in Canada (includes wood products) and the U.K., North American packaging companies (includes CB Pak Inc. and MacMillan Bathurst Inc.), and Europa Carton AG in Fed. Rep. Germany and the Netherlands.

In 1988, total net sales of pulp and paper were C$1.4 billion. Seven mills in Canada produced 1.73 million metric tons, while the Celgar mill produced 185,400 tons of market pulp. Shipments reached 1.03 million tons for newsprint and groundwood specialties, 348,000 tons for market pulp, and 335,000 tons for paperboard. [The company converted a kraft paper machine to newsprint specialties at Wayagamack (Trois Rivières, Que.) Div. in December 1988.]

Total capital expenditures in 1988 were C$345.4 million. Of that total, $213.4 million went to pulp and paper facilities ($175 million in Canada). Con-Bath planned to spend a total of $431.8 million in 1989.

In November 1988, a new 150,000-tpy corrugating medium machine started up at Bathurst (N.B.) Div. Ground was broken in early 1989 for a C$280-million 183,000-metric-tpy groundwood machine at Laurentide (Grand-Mère, Que.) Div. The machine, which will produce standard rotogravure paper "equivalent" to supercalendered paper, is scheduled to be completed by July 1990. In May 1989, the company announced it will shut down a 123-tpd machine at Belgo (Shawinigan, Que.) Div.

Con-Bath owns or controls 4,263 km2 of timberland in Canada.

Production facilities:

CASTLEGAR, B.C.
(Celgar Pulp Co.)
Pulp—560 metric tpd bleached kraft (for market) (CB's share: 280 tpd)

BATHURST, N.B.
Pulp—450 metric tpd bleached chemi-thermomechanical pulp; 275 tpd semichemical
Corrugating medium—300 metric tpd

GRAND-MÈRE, QUE.
(Laurentide Div.)
Pulp—345 metric tpd groundwood; 135 tpd very-high-yield sulfite
Groundwood specialties—510 metric tpd
Paperboard—100 metric tpd

NEW RICHMOND, QUE.
(Chaleurs Div.)
Pulp—535 metric tpd unbleached kraft
Linerboard—570 metric tpd

PORTAGE-du-FORT, QUE.
(Pontiac Div.)
Pulp—570 metric tpd bleached kraft (for market)

SHAWINIGAN, QUE.
(Belgo Div.)
Pulp—690 metric tpd groundwood; 270 tpd high-yield sulfite
Newsprint—890 metric tpd

TROIS RIVIÈRES, QUE.
(Wayagamack Div.)
Pulp—250 metric tpd unbleached and semibleached kraft; 300 tpd groundwood
Groundwood specialties—435 metric tpd

VILLE de la BAIE, QUE.
Port-Alfred Div.)
Pulp—430 metric tpd groundwood; 270 metric tpd high-yield sulfite; 245 metric tpd thermomechanical
Newsprint—975 metric tpd

Total production capacity:

PULP	
Kraft	1,635 metric tpd
Semichemical	275 metric tpd
Groundwood	1,765 metric tpd
TMP	245 metric tpd
BCTMP	450 metric tpd
Very-high-yield sulfite	135 metric tpd
High-yield sulfite	540 metric tpd
Total	5,045 metric tpd
PAPER AND BOARD	
Newsprint	1,865 metric tpd
Groundwood specialties	945 metric tpd
Linerboard	570 metric tpd
Corrugating medium	300 metric tpd
Paperboard	100 metric tpd
Total	3,904 metric tpd

Consolidated Papers Inc.

Box 8050
Wisconsin Rapids, Wis. 54495-8050
George W. Mead, chairman/chief executive officer

Net sales:	
1988	$896,804,000
1987	742,835,000
1986	653,040,000
1985	715,744,000
1984	686,328,000
Net income:	
1988	$149,883,000
1987	95,798,000
1986	87,542,000
1985	106,881,000
1984	80,588,000

Consolidated Papers is a leading producer of coated free-sheet and lightweight coated groundwood grades. Key to Consolidated's strategy are ongoing capital expenditure projects to improve productivity and quality at its five Wisconsin mills. This has enabled the company to retain its reputation as a low-cost, high-quality producer.

Total paper and paperboard shipments in 1988 were 960,081 short tons. Enamel papers accounted for 831,824 tons; specialty papers, 55,025 tons; and paperboard, 4,898 tons. Kraft (Wisconsin Rapids, Wis.) Div. supplied 227,834 tons of chemical pulp in 1988.

Capital spending in 1988 was $112.2 million, and $163.0 million was authorized for 1989.

A $46-million expansion was completed in mid-1989 at Kraft Div., boosting its capacity for kraft pulp from 680 tpd to 1,000 tpd. In spring 1989, the company broke ground for a $110-million lightweight coated specialty paper machine at Stevens Point (Wis.) Div. The 59,000-tpy machine, scheduled for startup in late 1990, will produce papers for consumer packaging and labels.

Consolidated owns 673,746 acres of timberland in the U.S. and Canada.

Production facilities:

STEVENS POINT, WIS.
(Stevens Point Div.)
Specialty paper—159 tpd

STEVENS POINT, WIS.
(Wisconsin River Div.)
Pulp—272 tpd groundwood
Book paper—624 tpd

WISCONSIN RAPIDS, WIS.
(Wisconsin Rapids Div.)
Enamel paper—651 tpd
Paperboard—105 tpd

WISCONSIN RAPIDS, WIS.
(Biron Div.)
Pulp—553 tpd groundwood
Book paper—1,042 tpd

WISCONSIN RAPIDS, WIS.
(Kraft Div.)
Pulp—704 tpd kraft

Total production capacity:

PULP	
Groundwood	825 tpd
Kraft	704 tpd
Total	1,529 tpd
PAPER AND BOARD	
Book paper	1,666 tpd
Enamel paper	651 tpd
Specialty paper	159 tpd
Paperboard	105 tpd
Total	2,581 tpd

Daishowa International

(Subsidiary of Daishowa Paper Manufacturing Co. Ltd., Japan)
Yomoji Saito, president

Financial data not available.

Daishowa America Co. Ltd.
(Subsidiary of Daishowa International)
1001 4th Ave. Plaza, Suite 3103
Seattle, Wash. 98154
Seiichi Taniguchi, executive vice president

Daishowa Paper Manufacturing Co. Ltd. is the second-largest paper and board producer in Japan. It has been assiduously acquiring assets in North America, often in the form of joint-venture partnerships.

In November 1987, James River Corp. announced it would sell its Port Angeles, Wash., groundwood papers mill (acquired with the purchase of Crown Zellerbach Corp. mills) to Daishowa America. In spring 1988, Daishowa conducted a feasibility study for addition of two new paper machines at Port Angeles—one for newsprint and the other for uncoated groundwood directory paper. In mid-1989, however, the company said it would postpone the two-phase expansion. The proposed project includes installation of a 224,000-metric-tpy newsprint machine by 1991 or 1992, followed by a 150,000-tpy directory paper machine by 1994. The cost of the project is estimated to be $560 million.

Daishowa is proceeding with a $22-million project to rebuild No. 3 directory paper machine at Port Angeles. The 216-tpd groundwood machine is being upgraded to match the paper quality of No. 2 machine, which has capacity for about 135 tpd. Daishowa plans to spend $3 million in 1990 to upgrade No. 2.

In August 1989, Daishowa America announced that, in a joint venture with Trans-Rim Enterprises Ltd., it plans to build a 350,000-tpy recycled linerboard mill on land leased from the Port of Stockton, Calif. The $200-million mill will produce mottled white and white-top linerboard as well as standard linerboard grades and some corrugating medium. The mill is expected to start up in early 1992.

Daishowa Canada Co. Ltd.
(Subsidiary of Daishowa International)
Box 11595, 650 W. Georgia St.
Vancouver, B.C. V6B 4N8
Koichi Kitatawa, vice president/general manager

Daishowa-Marubeni International Ltd. owns half of Cariboo Pulp & Paper Co.'s 260,000-metric-tpy bleached kraft pulp mill. (Weldwood of Canada Ltd. owns the other half.) A C$60-million modernization completed at this mill in June 1989 will eventually lift pulp capacity by 55,000 tpy to 315,000 tpy. The company currently has no plans to integrate the mill.

Daishowa Canada owns half of Quesnel River Pulp Co.'s thermomechanical and chemi-thermomechanical pulp mill, which was expanded and modernized in an $80-million project completed in late 1988. This project included the addition of a third pulp line with capacity for about 300 a.d. metric tpd of pulp.

In June 1988, Reed International plc announced it would sell its North American paper group to Daishowa Canada. The primary asset in the deal was a 417,000-metric-tpy newsprint mill in Quebec City, Que. The mill also makes 350,000 tpy of boxboard and 20,000 tpy of sulfite pulp sold on the market. Daishowa also got a flexible packaging business in Winnipeg, Man.; pigment manufacturing facilities in Toronto, Ont.; and lignin sulfonate plants in Quebec City and Rothschild, Wis.

Construction by Daishowa Canada of a 340,000-metric-tpy bleached kraft pulp mill in northern Alberta was given the go-ahead in early 1988. The C$500-million mill, near Peace River, Alta., is slated to start up in 1990. Using local aspen and equipped for oxygen delignification, the pulp mill will be one of the largest in Canada.

Production facilities:

PORT ANGELES, WASH. (100% ownership)
(Daishowa America Co. Ltd.)
Pulp—285 metric tpd stone groundwood, thermomechanical
Directory paper—390 metric tpd

QUESNEL, B.C. (25% ownership)
(Cariboo Pulp & Paper Co.)
Pulp—800 metric tpd bleached kraft
(Daishowa-Marubeni's share: 400 metric tpd)

QUESNEL, B.C. (50% ownership)
(Quesnel River Pulp Co.)
Pulp—900 metric tpd thermomechanical and BCTMP
(Daishowa Canada's share: 450 metric tpd)

QUEBEC CITY, QUE. (100% ownership)
(Reed Inc.)
Pulp—92 metric tpd sulfite pulp sold on market
Newsprint—1,175 tpd
Boxboard—98 tpd

PEACE RIVER, ALTA. (100% ownership)
(Daishowa Canada Co. Ltd.)
Pulp—958 metric tpd bleached hardwood kraft
* Mill will start up in 1991.

Total production capacity:
(excluding Peace River mill)

PULP	
Kraft	400 metric tpd
Groundwood/TMP	735 metric tpd
Sulfite	92 metric tpd
Total	1,227 metric tpd
PAPER	1,663 metric tpd

Daishowa Forest Products Ltd.

(formerly Reed Paper Inc.)
207 Queen's Quay West, Suite 880
Toronto, Ont. M5J 1A7
Koichi Kitagawa, president/chief executive officer

(Beneficially owned 100% by Daishowa Paper Manufacturing Co. Ltd. of Japan. In August 1988, the company purchased the North American manufacturing interests of Reed International plc. Financial statistics were not available for this edition.)

Daishowa Forest Products Ltd. produces mainly newsprint, along with market pulp, paperboard, lumber, chemicals, and packaging. Seventy-eight percent of company sales come from pulp, paper, and paperboard products.

In 1988, the company produced 485,000 metric tons of paper and paperboard as well as 21,000 tons of market pulp.

Capital spending in 1988 was C$83.6 million Spending in 1989 was expected to be $54.0 million.

Daishowa Forest Products will spend $122 million to install a 600-tpd chemi-thermomechanical pulp facility with supporting electrical woodhandling, as well as the site services to provide pulp for a 50-tpd increase in newsprint production. Startup is scheduled for July 1989.

Production facilities:

QUEBEC CITY, QUE.
Pulp—800 metric tpd groundwood; 400 metric tpd sulfite (60 tpd for market)
Newsprint—1,290 metric tpd
Paperboard—100 metric tpd

Total production capacity:

PULP	
Total	1,200 metric tpd
PAPER AND BOARD	
Total	1,390 metric tpd

Domtar Inc.

395 de Maisonneuve Blvd. W.
Montreal, Que. H3A 1L6
James H. Smith, chairman/chief executive officer

(More than 45% of Domtar is jointly owned by Caisse de Dépôt du Placement du Québec, and Soc. Générale de Financement du Québec.)

Net sales:	
1988	C$2,703,000,000
1987	2,568,000,000
1986	2,327,000,000
1985	2,130,000,000
1984	2,044,000,000
Net income:	
1988	C$111,000,000
1987	161,000,000
1986	145,000,000
1985	110,000,000
1984	90,000,000

Domtar is a producer of pulp, paper, lumber, packaging, construction materials, chemicals, and oil and gas. Pulp, paper, lumber, and packaging account for about 65% of its total sales. In 1988, Domtar sold its high-pressure laminates business and announced its intention to divest itself of its Chemicals Group and its gas and oil businesses. These actions are consistent with the company's strategic thrust to focus on forest products, packaging, and construction materials industries.

During the past three years, Domtar's Pulp & Paper Products Group has accounted for about 43% of consolidated sales, while its Packaging Group generated about 18% of these sales during the same period.

Domtar is Canada's largest manufacturer of fine papers, with sales in 1988 of C$709 million. Newsprint and groundwood specialties sales were C$343 million, market pulp and lumber sales were $159 million, and packaging products sales were $444 million.

In 1988, the company produced 416,000 metric tons of fine and specialty papers, 377,000 tons of newsprint, 128,000 tons of market pulp, and 427,000 tons of containerboard.

Capital spending in 1988 reached C$407 million, 75% of which was for pulp and papermaking facilities. A $1-billion rehabilitation is still under way at the fine papers complex at Windsor, Que. Two new paper machines with a combined capacity of 350,000 short tpy and a 330,000-tpy integrated pulp mill will be added, bringing Domtar's total fine papers capacity to 740,000 tpy. The first machine came online in July 1988, and the second was scheduled to start up in 1989.

In 1989, the company spent C$30 million on a 24,000-metric-tpy modernization and expansion program at its newsprint mill at Red Rock, Ont. In August 1989, Domtar closed its fine papers mill at Don Valley (Toronto), Ont.

Domtar owns 990,000 acres of timberland in Canada and the U.S., and it has cutting rights on another 7.7 million acres in Canada. About half of the company's 2.8 million metric tons of pulp requirements came from these lands in 1988.

Production facilities:

Pulp & Paper Products Group:

CORNWALL, ONT.
(Fine Papers Div.)
Pulp—333 metric tpd kraft
Fine paper—756 metric tpd

ST. CATHARINES, ONT.
(Fine Papers Div.)
Fine paper—180 metric tpd

BEAUHARNOIS, QUE.
(Fine Papers Div.)
Fine paper—57 metric tpd

DOLBEAU, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—600 metric tpd chemi-thermomechanical
Newsprint—500 metric tpd

DONNACONA, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—500 metric tpd thermomechanical
Newsprint and groundwood printing paper—500 metric tpd

LEBEL-sur-QUEVILLON, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—720 metric tpd kraft (for market)

WINDSOR, QUE.
(Fine Papers Div.)
Pulp—227 metric tpd kraft
Fine paper—450 metric tpd

Packaging Group:

MISSISSAUGA, ONT.
Linerboard—256 metric tpd

RED ROCK, ONT.
Pulp—773 metric tpd kraft; 166 tpd groundwood
Linerboard—651 metric tpd
Newsprint—202 metric tpd

TRENTON, ONT.
Pulp—136 metric tpd semichemical
Corrugating medium—312 metric tpd

Construction Materials Group, Gypsum Products:

SAN LEANDRO, CALIF.
(Domtar Gypsum Inc.)
Chipboard, gypsum linerboard—150 short tpd (136 metric)

VERNON, CALIF.
(Domtar Gypsum Inc.; formerly Genstar Gypsum Products Co. mill)
Gypsum paper—150 short tpd (136 metric)

LOCKPORT, N.Y.
(Upson Products Div.
Gypsum linerboard—170 short tpd (154 metric)

Total production capacity:

PULP	
Kraft	2,053 metric tpd
Groundwood	166 metric tpd
Semichemical	136 metric tpd
TMP	500 metric tpd
CTMP	600 metric tpd
Total	3,455 metric tpd
PAPER AND BOARD	
Newsprint, groundwood printing	1,202 metric tpd
Fine paper	1,443 metric tpd
Linerboard	907 metric tpd
Corrugating medium	312 metric tpd
Gypsum paper/board	426 metric tpd
Total	4,290 metric tpd

Donohue Inc.

1150 Claire-Fontaine
Quebec City, Que. G1R 5G4
Charles-Albert Poissant, chairman/chief executive officer

(In July 1987, the Quebec government, through its Dofor Inc. subsidiary, completed the sale of its 55.25% share in Donohue to a new firm, Mircor Inc., owned by Quebecor Inc. of Montreal, Que., and Maxwell Communication Corp. plc of London, U.K., which have 51% and 49% of the shares, respectively, and thus 29% and 27% of Donohue.

(Donohue owns 55% of Donohue St-Félicien Inc.; Fletcher Challenge Canada Ltd. owns 45%. Donohue owns 58.1% of Donohue Normick Inc.; Normick Perron Inc. owns 41.9%. At the four-machine mill at Clermont, Que., Donohue owns 55.4% of one-machine Donohue Charlevoix Inc.; Gannett Co. Inc. owns 44.6%. Donohue owns 51% of Donohue Malbaie Inc., also at Clermont; the New York Times Co. owns 49%. In addition, Donohue has two other paper machines at this mill.)

Net sales:	
1988	C$648,337,000
1987	510,054,000
1986	475,610,000
1985	424,971,000
1984	438,613,000
Net income:	
1988	C$68,691,000
1987	44,247,000
1986	24,473,000
1985	20,673,000
1984	30,288,000

Donohue Inc. has been a heavy capital spender during the past decade with its involvement in construction of the C$280-million pulp mill in 1978 (Donohue St-Félicien), a greenfield newsprint mill in 1982 (Donohue Normick Inc.), and a new thermomechanical pulping system and newsprint machine at its existing newsprint mill. As a result, Donohue has some of the most modern, large-scale mills in the Canadian industry.

Market pulp output in 1988 was 298,739 metric tons, and newsprint production was 525,145 tons. Of the total for newsprint, 350,965 tons were produced at the Clermont mill and 174,181 tons came from the Amos, Que., mill.

Total capital expenditures in 1988 were C$29,738,000, and the company expected to spend $19,485,000 in 1989.

In July 1988, Donohue Malbaie inaugurated a C$139-million, 180,000-metric-tpy newsprint machine at Clermont. In September 1988, Donohue officially announced plans to build a C$289.5-million, 190,000-metric-tpy bleached chemi-thermomechanical pulp mill at Matane, Que. The mill will be built and managed by Donohue Matane Inc., a new company that is held 50% by Donohue and 50% by Rexfor, a Quebec Crown corporation. The mill is scheduled to be online in November 1990.

Production facilities:

AMOS, QUE.
(Donohue Normick Inc.)
Pulp—535 metric tpd thermomechanical
Newsprint—470 metric tpd

CLERMONT, QUE.
Pulp—1,100 metric tpd thermomechanical; 150 metric tpd sulfite; 615 tpd groundwood
Newsprint—715 metric tpd

MATANE, QUE.
(Donohue Matane Inc. proposed mill)
Pulp—535 metric tpd bleached chemi-thermomechanical

ST-FÉLICIEN, QUE.
(Donohue St-Félicien)
Pulp—850 metric tpd bleached kraft for market (Donohue's share—468 tpd)

Total production capacity:

PULP	
Sulfite	150 metric tpd
Groundwood	615 metric tpd
TMP	1,635 metric tpd
Kraft	468 metric tpd
Total*	2,868 metric tpd

* Does not include Matane.

PAPER	
Newsprint	1,185 metric tpd

Eddy Paper Co. Ltd.

1335 Carling Ave.
Box 3521, Station C
Ottawa, Ont. K1Y 4L5
E.F. Boswell, president/chief operating officer

(A wholly owned subsidiary of George Weston Ltd., Eddy Paper in turn owns E.B. Eddy Forest Products Ltd.)

Net sales, Forest Products:

1988	C$788,319,000
1987	659,165,000
1986	584,422,000
1985	526,000,000
1984	533,000,000

Operating income:

1988	C$93,000,000
1987	68,000,000
1986	56,000,000
1985	36,000,000
1984	40,000,000

Eddy Paper Co. Ltd. is a producer of fine paper, tissue, specialty papers, and market pulp. It transfers market pulp from its 340,000-metric-tpy Espanola, Ont., mill to its nonintegrated paper mills at Ottawa, Ont.; Hull, Que.; and Port Huron, Mich. About 175,000 tons of market pulp are sold on the outside.

About 91% of total sales are derived from the pulp and paper sector. In 1988, Eddy produced 395,848 short tons of paper and 374,433 tons of pulp.

Capital expenditures in 1988 were C$61 million, and the company expected to spend $80 million in 1989.

In March 1989, the White Swan Div. at Hull, Que., was sold to Scott Paper Ltd. An agreement to sell Eastern Fine Paper Inc. to Precor Corp. was completed in early April. Net proceeds in the C$100-million range will be redirected to existing operations and new investments.

Eddy cuts timber on 6,600 mi² of Crown woodlands in Canada.

Production facilities:

ESPANOLA, ONT.
(E.B. Eddy Forest Products)
Pulp—1,000 metric tpd kraft (520 tpd for market)
Fine and specialty paper—140 metric tpd

OTTAWA, ONT.
(E.B. Eddy Forest Products)
Fine and specialty paper—168 metric tpd

HULL, QUE.
(E.B. Eddy Forest Products)
Fine and specialty paper—260 metric tpd

PORT HURON, MICH.
(E.B. Eddy Paper Inc., former Port Huron Paper Corp. mill owned by Pentair Inc.)
Specialty paper—235 short tpd (213 metric)

Total production capacity:

PULP	1,000 metric tpd
PAPER Fine/specialty	781 metric tpd

Eurocan Pulp & Paper Co.

Box 1400
Kitimat, B.C. V8C 2H1
Kari Suopanki, president/chief executive officer

[Eurocan is a joint venture between Enso Forest Products Ltd. (division of Enso-Gutzeit Oy, Finland) and West Fraser Timber Co. Ltd.]

Net sales (C$):

1988	Not available
1987	C$318,000,000
1986	283,000,000
1985	236,000,000
1984	210,000,000

Since starting up in 1971 under the ownership of three Finnish companies, this interior British Columbian mill has had an uneven financial performance due to market fluctuations for its principal products—linerboard and kraft paper. The company has undergone several ownership changes, the most recent when West Fraser bought 50% control in 1981-84.

In 1988, the mill had linerboard sales of 244,989 metric tons, and it sold 111,394 tons of sack kraft paper. Its major market is Japan.

In spring 1988, Eurocan announced a C$126-million project to raise linerboard capacity by 105,000 metric tpy and increase pulping capacity by an equivalent amount. In June 1989, the wet end rebuild of the linerboard machine was completed. A new winder was installed in March. A new chemimechanical pulp line started up in October, at which time the linerboard machine was making 800 tpd. The mill planned to make 1,000 tpd of linerboard by year-end 1989.

Production facilities:

KITIMAT, B.C.
Pulp—950 metric tpd kraft
Linerboard and kraft paper—1,010 metric tpd

Total production capacity:

PULP	950 metric tpd
PAPER AND BOARD	1,010 metric tpd

Federal Paper Board Co. Inc.

75 Chestnut Ridge Rd.
Montvale, N.J. 07645
John R. Kennedy Jr., president/chief executive officer

Net sales:

1988	$1,116,941,000
1987	1,025,727,000
1986	948,560,000
1985	783,927,000
1984	637,450,000

Net income:

1988	$143,000,000
1987*	65,763,000
1986*	18,410,000
1985	11,196,000
1984	37,075,000

* After extraordinary charge of $8,217,000 in 1987 and $15,125,000 in 1986.

Federal's operations are in three divisions: Forest Products (bleached paperboard and pulp, wood products, and lumber); Recycled Paperboard; and Packaging and Printing. All but 1% of sales are derived from pulp, paper, paperboard, and converting operations.

Total sales in 1988 of bleached paperboard and pulp were $777.8 million. Net sales to unaffiliated customers were $479.3 million for bleached paperboard and $257.7 million for pulp. Total recycled paperboard sales were $87.5 million.

In 1988, Federal produced 799,493 tons of bleached paperboard, 482,709 tons of market pulp, and 169,408 tons of recycled paperboard.

Total capital expenditures in 1988 were $204.3 million, including $152.3 million for bleached paperboard and pulp operations. Federal expected to spend a total of $425 million in 1989.

The company completed Phase I and began Phase II of its $530-million capital program at the Augusta, Ga., bleached paperboard mill. Phase II includes a paperboard capacity expansion to 1,860 tpd and rebuilds of two of the mill's three machines. Phase III will include installation of a fourth paperboard machine, bringing mill capacity to 2,500 tpd. Completion is scheduled for 1992.

In 1988, Federal also began a $7-million, 100-tpd capacity expansion at the Sprague (Versailles, Conn.) Div. recycled paperboard mill. Startup is scheduled for late 1989.

The company sold its recycled paperboard mills at Richmond, Va., and Los Angeles, Calif., in 1988. At mid-year, it acquired United Paper Inc., with two sheeting plants located in Sturgis, Mich., and Ontario, Calif.

Federal owns 553,000 acres of timberland in the U.S., and it leases an additional 135,000 acres.

Production facilities:

VERSAILLES, CONN.
(Sprague Div.)
Recycled board—510 tpd

AUGUSTA, GA.
Pulp—1,285 tpd bleached kraft (110 tpd for market)
Bleached paperboard—1,290 tpd

RIEGELWOOD, N.C.
Pulp—2,146 tpd bleached kraft (1,258 tpd for market)
Bleached paperboard—910 tpd

Total production capacity:

PULP	3,431 tpd
PAPERBOARD	
Bleached paperboard	2,200 tpd
Recycled paperboard	510 tpd
Total	2,710 tpd

Fletcher Challenge Canada Ltd.

700 West Georgia St.
Box 10058, Pacific Centre
Vancouver, B.C. V7Y 1J7
Ian Donald, president/chief executive officer

(FCC owns 100% of Blandin Paper Co., 45% of Donohue St-Felicien Inc., and 50% of Finlay Forest Industries Ltd. In late 1989, FCC sold its 22.7% stake in Western Forest Products Ltd., the parent of Western Pulp Ltd. Partnership of British Columbia, to Doman Industries Inc.)

Net sales:	
1988	C$1,471,532,000
1987	1,400,427,000
1986	1,100,900,000
1985	1,140,000,000
1984	1,014,700,000
Net earnings:	
1988	C$182,200,000
1987	140,200,000
1986	40,200,000
1985	30,100,000
1984	9,200,000

In September 1988, shareholders of British Columbia Forest Products Ltd. approved a plan by parent company Fletcher Challenge Ltd. of New Zealand to jointly operate its Canadian holdings, creating a new company called Fletcher Challenge Canada Ltd., based in Vancouver, B.C. FCC accomplished this without having to buy out BCFP's minority shareholders.

Under the plan, BCFP and Crown Forest Industries Ltd. are run by the new company, essentially merging the two operations, although FC owns just 69% of BCFP. To accomplish this, FC awarded BCFP a contract to manage its wholly owned CFI operations for a fee. The merger enabled FCC to combine functions such as marketing, accounting, and administration, and to concentrate on expansions and modernizations. Capital spending in 1988 amounted to C$306 million.

In March 1989, Finlay Forest Industries Ltd. started up a new 216,000-metric-tpy newsprint machine at its mill in Mackenzie, B.C. This is the first newsprint machine ever to be constructed in the British Columbia interior. Although the new machine has a rated capacity of 216,000 tpy, it can only make 180,000 tpy because of limited pulp capacity.

Adjacent to Finlay Forest is a 600-tpd bleached kraft pulp mill wholly owned by FCC. In early 1989, the company said it was considering spending about C$90 million to debottleneck the mill, a process that would add 100 tpd of capacity.

In October 1989, Blandin Paper Co. started up a new lightweight coated groundwood paper machine with capacity for 254,000 short tpy. The $323-million project increased mill capacity by 80% from 300,000 tpy to 500,000 tpy of paper.

FCC is in the midst of a C$260-million expansion/modernization project at its Crofton, B.C., newsprint and market pulp mill. The project, which will lift market pulp capacity by 75,000 metric tpy, is scheduled for completion in 1991.

In May 1989, FCC announced it would spend C$33 million to make the Elk Falls, B.C., mill the first in western North America to produce soft roll calendered paper—a special high-gloss paper used for advertising inserts and flyers. Conversion of No. 2 newsprint machine will be completed by mid-1990. Initial production of 20,000 metric tpy will grow to at least 60,000 tpy over three years. This is part of FCC's strategy to add value to standard newsprint at a time when newsprint markets are softening.

Production facilities:

CAMPBELL RIVER, B.C.
(Elk Falls Mill of Crown Forest Industries)
Pulp—1,035 metric tpd kraft (510 tpd bleached for market); 1,250 tpd thermomechanical
Newsprint—1,280 metric tpd
Kraft specialties and linerboard—240 metric tpd

CROFTON, B.C.
(Crofton Pulp & Paper Div.)
Pulp—1,000 metric tpd kraft (750 tpd for market); 940 metric tpd mechanical
Newsprint and specialty paper—1,300 metric tpd

MACKENZIE, B.C.
(Mackenzie Div.)
Pulp—600 metric tpd kraft (for market)

MACKENZIE, B.C.
(Finlay Forest Industries Ltd.)
Pulp—450 metric tpd groundwood
Newsprint—605 metric tpd

ST-FELICIEN, QUE.
(Donohue St-Felicien Inc.)
Pulp—850 metric tpd bleached kraft (FCC's share: 396 tpd)

GRAND RAPIDS, MINN.
(Blandin Paper Co.)
Pulp—330 short tpd (299 metric) mechanical
Coated groundwood—820 short tpd (744 metric)

Total production capacity:

PULP	
Kraft	3,485 metric tpd
TMP	1,250 metric tpd
Mechanical	1,239 metric tpd
Groundwood	450 metric tpd
Total	6,424 metric tpd
PAPER AND BOARD	
Newsprint and specialty	3,185 metric tpd
Kraft specialties and linerboard	240 metric tpd
Coated groundwood	744 metric tpd
Total	4,169 metric tpd

Fort Howard Corp.

1919 S. Broadway
Green Bay, Wis. 54304-9191
Paul J. Schierl, chairman/chief executive officer

Net sales:	
1987	$1,757,728,000
1986	1,549,290,000
1985	1,363,292,000
1984	1,338,588,000
Net earnings:	
1987	$157,738,000
1986	146,391,000
1985	157,010,000
1984	133,076,000

Fort Howard was taken private in a $3.57-billion leveraged buyout in August 1988. The company did not put out annual sales and earnings figures in that year. It said that because of accounting methods, the figures from before and after the LBO cannot be compared.

Fort Howard is the largest U.S. producer of tissue products sold on the commercial and industrial market. It commands about a 31% share of the U.S. C&I market. Because of the huge debt load it incurred by going private, Fort Howard was forced to postpone some of its expansion plans in the tissue sector of its business. In order to generate much needed cash to pay down its debt and proceed with capital investments, the company sold off its disposable foodservice products business to a private investor group led by executives of Silgan Corp. of Stamford, Conn., in September 1989. Fort Howard did not reveal the sale price, but the unit had worldwide sales in 1988 of about $925 million.

The operations sold included the former Maryland Cup Corp., which Fort Howard bought in 1983 for $536.2 million, and Lily-Tulip Inc., which was purchased in 1986 for $326 million.

In July 1989, Fort Howard announced an ambitious capital spending program. The company once again said it would add a fourth tissue machine at its greenfield mill in Rincon, Ga.—a plan that was put on hold when the LBO occurred. The fourth tissue machine at the Savannah River mill is slated to start up in mid-1991. The cost of the machine and related equipment is about $125 million.

At the same time, Fort Howard said it will add three tissue machines to its mills in the next five years. In addition to the reinstated fourth machine at Rincon, the company plans to seek permits to expand its three-machine tissue mill in Muskogee, Okla., and its mill in Green Bay, Wis. In April 1989, the company started up a dry form tissue machine at Green Bay, giving the mill eight tissue machines and two dry formers.

Production facilities:
(Fort Howard does not release capacity data; figures below are estimates.)

RINCON, GA.
(Savannah River Mill)
Tissue, towels, napkins—750 tpd

MUSKOGEE, OKLA.
Tissue, towels, napkins—975 tpd

GREEN BAY, WIS.
Tissue, towels, napkins—990 tpd

Total production capacity:

PAPER	
Tissue, towels, napkin	2,715 tpd

Garden State Paper Co. Inc.

600 E. Broad St.
Richmond, Va. 23219
Basil Snider Jr., president/chief executive officer

(A wholly-owned subsidiary of Media General Inc., which also has a 33% interest in Southeast Paper Mfg. Co. FSC Paper Corp., in which Media General had a 20% interest, was sold to Smorgon Consolidated Industries Pty Ltd. of Australia in May 1987.)

Garden State Paper Co. Inc.	
Net sales:	
1986	$169,989,000
1985	170,713,000
1984	179,024,000

Media General Inc.	
Newsprint segment revenues:	
1988	$226,000,000
1987	204,113,000
1986	173,402,000
1985	174,893,000
1984	182,333,000
Operating profit:	
1988	$44,300,000
1987	36,278,000
1986	17,284,000
1985	17,730,000
1984	19,860,000

Media General is the fourth-largest newsprint producer in the U.S., following the sale of its interest in FSC. Garden State mills recycle about 8% of all newspapers read annually in the U.S. The mills utilize the Garden State technology for making newsprint.

In March 1989, the Pomona, Calif., newsprint recycling mill was sold to Barris Industries/Giant Group Ltd.

A $12-million rebuild of No. 2 machine at Garfield, N.J., was completed in early 1989. In addition, a new $5-million pressurized slotted screen washing system was installed at the mill in early 1988.

A new machine at Southeast's Dublin, Ga., mill will double capacity to 460,000 tpy. The $330-million project was scheduled to start up in September 1989.

Production facilities:

GARFIELD, N.J.
Pulp—700 tpd deinked
Newsprint—600 tpd

Total production capacity:

PULP	700 tpd
PAPER	600 tpd

Gaylord Container Corp.

500 Lake Cook Rd., Suite 400
Deerfield, Ill. 60015
Marvin A. Pomerantz, chairman/chief executive officer

Net sales:	
1988	$671,200,000
1987*	437,800,000
Net income:	
1988	$41,900,000
1987*	19,300,000

(fiscal year ends Sept. 30)
* = For the 10-month period between Nov. 1986 and Sept. 1987.

Gaylord initially consisted of Mid-America Packaging and three mills formerly owned by Crown Zellerbach Corp. Early in 1988, Gaylord acquired assets of the container products division of Louisiana-Pacific Corp.'s Fibreboard Corp. subsidiary. In July 1988, Gaylord Container became a public company. In November 1988, its Baltimore, Ohio, recycled paper mill was sold for $17 million.

The company manufactures and markets corrugated containers, containerboard, unbleached kraft paper, and multiwall bags. Its domestic network consists of three paper mills, 21 corrugated container plants, and a multiwall bag facility. Gaylord's operating strategy is to purchase undervalued assets and pump capital into them.

The company has embarked on an ambitious $440-million program to increase capacity by 50%, improve product quality, and reduce per-unit costs. The largest item is a new 1,000-tpd linerboard machine at the Bogalusa, La., mill, scheduled to start up in mid-1990. The two Antioch, Calif., mills will be linked for cost savings. Included in this project are a pulp mill upgrade and a rebuild of No. 4 machine.

In 1988, production of containerboard and unbleached kraft paper was 1.13 million tons.

Production facilities:

PINE BLUFF, ARK.
(Mid-America Packaging Inc.)
Pulp—330 tpd kraft
Paper—425 tpd bag, sack

ANTIOCH , CALIF.
Recycled paperboard—600 tpd

ANTIOCH, CALIF.
(Former Fibreboard Corp., Container Products Div. mill)
Pulp—600 tpd unbleached kraft; 200 tpd semichemical
Linerboard—625 tpd
Corrugating medium—225 tpd

BOGALUSA, LA.
Pulp—1,300 tpd unbleached kraft; 330 tpd semichemical
Bag paper—350 tpd
Containerboard—1,350 tpd

Total production capacity:

PULP	
Kraft	2,230 tpd
Semichemical	530 tpd
Total	2,760 tpd
PAPER AND BOARD	
Bag paper	775 tpd
Containerboard	2,200 tpd
Recycled paperboard	600 tpd
Total	3,575 tpd

Georgia-Pacific Corp.

133 Peachtree St. N.E.
Atlanta, Ga. 30303
T. Marshall Hahn Jr., chairman/chief executive officer

Net sales:	
1988	$9,509,000,000
1987	8,603,000,000
1986	7,223,000,000
1985	6,716,000,000
1984	6,682,000,000
Net income:*	
1988	$467,000,000
1987	458,000,000
1986	296,000,000
1985	207,000,000
1984	253,000,000

*continuing operations, before unusual items

Georgia-Pacific, one of the largest U.S. producers of building materials, has modified its strategy to achieve a better balance between its paper and building products sectors and to even out performance in business cycles. It is also integrating further, installing two white paper machines at Port Hudson, La., where there was formerly only a market pulp operation. It has switched grades from one mill to another or added grades for optimum mill performance. G-P got out of the chemicals and oil and gas businesses, but has added cut-size converting operations at three mills.

In August 1988, the company acquired Brunswick Pulp & Paper Co. from Mead Corp. and Scott Paper Co. for $665 million, expanding G-P's position in market pulp and bleached board.

Sales of pulp and paper in 1988 were $3.44 billion (36% of G-P's total sales). Of this amount, containerboard and packaging accounted for 15% or $1.43 billion, printing/writing papers 8% ($796 million), tissue 6% ($590 million), market pulp 6% ($533 million), and other grades 1% ($84 million).

In 1988, pulp output was 4,218,000 short tons. Paper production included 1,297,000 tons of linerboard and medium, 970,000 tons of printing/writing papers, 458,000 tons of other paperboard, 511,000 tons of tissue and sanitary papers, and 356,000 tons of kraft paper. G-P had capacity at the end of 1988 for 5,310,000 tons of pulp and 4,366,000 tons of paper.

Capital expenditures in 1988 were $520 million for pulp and paper projects.

Construction of a new recovery boiler was completed in mid-1989 at the Woodland, Maine, mill, adding 26,000 tpy of pulp capacity.

In August 1988, G-P started up a new 290,000-tpy white paper machine at the Port Hudson, La., mill, making it the second-largest manufacturer of uncoated free-sheet in North America.

A rebuild of No. 2 linerboard machine at Monticello, Miss., was completed in 1988, adding 177,000 tpy of capacity. No. 1 machine was rebuilt following acquisition of the mill in 1984.

The company plans to rebuild No. 1 bleached board machine at Crossett, Ark. The project is scheduled for completion in late 1990 and will add 10,000 tpy of capacity.

G-P owns 5,480,000 acres of timberland in North America, and it controls 1,010,000 acres.

Production facilities:

BRUNSWICK, GA.
Pulp—1,800 tpd kraft (1,470 market)
Bleached board—530 tpd

CROSSETT, ARK.
Pulp—1,510 tpd kraft; 127 tpd deinked
Printing paper—507 tpd
Tissue and towel—456 tpd
Solid bleached board—482 tpd

PALATKA, FLA.
Pulp—1,366 tpd kraft (68 tpd for market); 20 tpd deinked
Kraft paper—620 tpd
Tissue & toweling—479 tpd

TAYLORVILLE, ILL.
Pulp—17 tpd deinked
Printing/writing paper—115 tpd

GARY, IND.
Pulp—76 tpd deinked
Industrial toweling—76 tpd

PORT HUDSON (Zachary), LA.
Pulp—1,245 tpd bleached kraft (1,198 for market)
Printing paper—600 tpd

WOODLAND, MAINE
Pulp—839 tpd kraft (461 tpd for market)
Printing paper—310 tpd

KALAMAZOO, MICH.
Pulp—127 tpd deinked
Printing paper—394 tpd

MONTICELLO, MISS.
Pulp—2,214 tpd kraft
Kraft linerboard—2,775 tpd

DELAIR, N.J.
Pulp—237 tpd deinked
Gypsum paperboard—206 tpd

PLATTSBURGH, N.Y.
Pulp—107 tpd semichemical; 28 tpd deinked
Tissue and towel—254 tpd

PRYOR, OKLA.
Pulp—225 tpd deinked
Gypsum paperboard—239 tpd

TOLEDO, ORE.
Pulp—1,386 tpd kraft; 434 tpd deinked
Kraft paper—338 tpd
Kraft linerboard—941 tpd
Semichemical medium—493 tpd

READING, PA.
Pulp—14 tpd deinked
Printing paper—71 tpd

GILMAN, VT.
Pulp—28 tpd deinked
Printing paper—200 tpd

BELLINGHAM, WASH.
Pulp—577 tpd bleached sulfite (367 tpd for market); 113 tpd semichemical; 34 tpd deinked
Tissue and towel—248 tpd

THOROLD, ONT.
(Beaver Wood Fibre Co.)
Pulp—294 metric tpd deinked (324 short)
Gypsum paperboard—281 metric tpd (310 short)

Total production capacity:

PULP (short tons)	
Kraft	10,360 tpd
Semichemical	220 tpd
Sulfite	577 tpd
Deinked	1,691 tpd
Total	12,848 tpd
PAPER (short tons)	
Printing/writing	2,197 tpd
Tissue/toweling	1,437 tpd
Kraft paper	958 tpd
Industrial toweling	76 tpd
Total	4,668 tpd
PAPERBOARD (short tons)	
Kraft linerboard	3,716 tpd
Bleached board	1,012 tpd
Semichemical medium	493 tpd
Gypsum paperboard	755 tpd
Total	5,976 tpd
TOTAL PAPER AND BOARD	10,644 tpd

Gilman Paper Co.

111 W. 50th St.
New York, N.Y. 10020
Howard Gilman, chairman/chief executive officer

Financial data not available.

Net sales for the company were $362 million in 1988 and $332 million in 1987. Approximately 75% of 1988 sales came from pulp, paper, and board products.

Production in 1988 was 419,000 short tons of paper and paperboard and 410,000 tons of pulp.

Total capital expenditures in 1988 were $28 million, with about 80% of the amount dedicated to pulp and paper operations. Gilman expected to spend a total of $15 million in 1989.

The company owns 195,000 acres of timberland in the U.S., and it controls 43,000 acres.

Production facilities:

ST. MARYS, GA.
(St. Marys Kraft Div.)
Pulp—1,200 tpd kraft (750 tpd bleached, 450 tpd unbleached)
Paper and board—1,200 tpd (half paper, half board; bleached and unbleached; coated and uncoated)

Total production capacity:

PULP	1,200 tpd
PAPER AND BOARD	1,200 tpd

P.H. Glatfelter Co.

228 Main St.
Spring Grove, Pa. 17362
T.C. Norris, chairman/president/chief executive officer

(Glatfelter Pulp Wood Co. is a wholly owned subsidiary.)

Net sales:	
1988	$569,333,000
1987	423,680,000
1986	284,832,000
1985	277,144,000
1984	310,883,000
Net earnings:	
1988	$82,232,000
1987	55,027,000
1986	41,474,000
1985	39,731,000
1984	63,186,000

Glatfelter manufactures printing/writing and specialty papers. The company's strategy is to serve niche markets with high-value products, and it emphasizes customer service. Ecusta Div., the only integrated cigarette paper mill in the U.S., is developing new, non-tobacco markets to offset any future declines in cigarette consumption.

The mill at Spring Grove, Pa., is integrated, producing a substantial part of its pulp requirements from wood. The Neenah, Wis., mill recycles wastepaper for its principal raw material. All company sales are derived from paper and paperboard.

In 1988, Glatfelter produced 503,500 short tons of paper and paperboard and 303,100 tons of pulp.

Capital expenditures in 1988 were $47.9 million, and the company expected to spend $64.7 million in 1989.

A $63-million fluidized bed power boiler/turbine generator at Spring Grove, Pa., was scheduled for completion in mid-1989. It will make the mill self-sufficient in energy and provide electricity to sell.

Company timberlands, managed by Glatfelter Pulp Wood Co., comprise 107,000 acres.

Production facilities:

PISGAH FOREST, N.C.
(Formerly Ecusta Corp. mill)
Pulp—100 tpd flax
Cigarette and thin—250 tpd

SPRING GROVE, PA.
Pulp—580 tpd bleached kraft
Uncoated free-sheet—700 tpd
Coated free-sheet—115 tpd

NEENAH, WIS.
(Bergstrom Paper Div.)
Pulp—250 tpd bleached deinked
Printing/writing—390 tpd

Total production capacity:

PULP	
Kraft	580 tpd
Deinked	250 tpd
Flax	100 tpd
Total	930 tpd
PAPER	
Printing/writing	1,205 tpd
Cigarette and thin	250 tpd
Total	1,455 tpd

Great Northern Nekoosa Corp.

401 Merritt 7, P.O. Box 5120
Norwalk, Conn. 06856-5120
William R. Laidig, chairman/president/chief executive officer

(Kymmene Corp. of Finland owns 5% of Leaf River Forest Products)

Net sales:	
1988	$3,588,100,000
1987	2,589,000,000
1986	2,039,200,000
1985	1,934,800,000
1984	1,873,300,000
Net income:	
1988	$341,700,000
1987	200,600,000
1986	85,300,000
1985	46,200,000
1984	119,900,000

GNN has six operating divisions: Leaf River Forest Products makes and sells market pulp; Nekoosa Papers, business communication papers; Great Northern Paper, newsprint and other groundwood papers; Great Southern Paper and Nekoosa Packaging, containerboard and corrugated containers; and Butler Paper, merchant and envelope converting operations. The company's strategy is to produce a few high-volume products at large, cost-efficient mills.

In 1988, GNN acquired Jim Walter Papers, a paper distributor and envelope manufacturer that now operates as part of Butler Paper.

Ninety-five percent of GNN's sales come from pulp/paper/board products. In 1988, the company produced 1,604,000 short tons of paper (capacity: 1,645,000 tons); 2,132,000 tons of containerboard (capacity: 2,190,000 tons); and 537,000 tons of market pulp (capacity: 570,000 tons).

Business papers accounted for 20.7% of

shipments, newsprint and groundwood 17.9%, and containerboard 48.6%. The Leaf River Forest Products market pulp mill, which started up in 1984, has become a major profit contributor despite its high original capital cost ($560 million). It accounted for 12.8% of sales in 1988.

Capital expenditures in 1988 were $282.4 million, and GNN expected to spend $550 million in 1989.

In January 1989, the company announced a $500-million expansion of the Nekoosa Papers mill at Ashdown, Ark. The project includes a new 325,000-tpy uncoated free-sheet paper machine, which will be the world's largest such machine upon startup in mid-1991. In April 1989, the mill completed construction of a $90-million recovery boiler that will increase market pulp production by 90,000 tpy.

GNN owns 3.4 million acres of timberland in the U.S. and controls 300,000 acres.

Production facilities:

ASHDOWN, ARK.
(Nekoosa Papers)
Pulp—1,700 tpd bleached kraft (140 tpd for market)
Business communication paper—1,340 tpd

CEDAR SPRINGS, GA.
(Great Southern Paper)
Pulp—2,395 tpd kraft; 515 tpd semichemical
Linerboard—2,395 tpd
Corrugating medium—665 tpd

EAST MILLINOCKET, MAINE
(Great Northern Paper)
Pulp—725 tpd groundwood
Newsprint—920 tpd

MILLINOCKET, MAINE
(Great Northern Paper)
Pulp—710 tpd groundwood; 525 tpd sulfite
Groundwood paper, newsprint—1,215 tpd

NEW AUGUSTA, MISS.
(Leaf River Forest Products)
Pulp—1,540 tpd bleached kraft pulp (for market)

NEKOOSA, WIS.
(Nekoosa Papers)
Pulp—380 tpd kraft
Business communication paper—612 tpd

PORT EDWARDS, WIS.
(Nekoosa Papers)
Pulp—250 tpd sulfite
Business communication paper—450 tpd

VALDOSTA, GA.
(Nekoosa Packaging Corp.)
Pulp—1,125 tpd kraft
Linerboard—1,075 tpd

BIG ISLAND, VA.
(Nekoosa Packaging Corp.)
Pulp—720 tpd semichemical
Corrugating medium—815 tpd

TOMAHAWK, WIS.
(Nekoosa Packaging Corp.)
Pulp—1,075 tpd semichemical
Corrugating medium—1,245 tpd

Total production capacity:

PULP	
Kraft	7,140 tpd
Semichemical	2,310 tpd
Groundwood	1,435 tpd
Sulfite	775 tpd
Total	11,660 tpd
PAPER AND BOARD	
Newsprint, groundwood	2,135 tpd
Business papers	2,402 tpd
Linerboard	3,470 tpd
Corrugating medium	2,725 tpd
Total	10,732 tpd

Green Bay Packaging Inc.

Box 1107
Green Bay, Wis. 54305
James F. Kress, president/chief executive officer

Financial data not available.

Green Bay is a diversified, privately owned company with interests in containerboard, converting, lumber, and machinery. Arkansas Kraft, formerly a subsidiary, became a division in March 1987.

Containerboard output at Arkansas Kraft in 1988 was 346,294 short tons, which included 126,837 of mottled white. The Green Bay mill produced 142,584 tons of board.

In 1989, the company announced plans to expand the Green Bay medium mill by 300 tpd and Arkansas Kraft by 425 tpd.

Green Bay owns 195,000 acres of timber in the U.S.

Production facilities:

MORRILTON, ARK.
(Arkansas Kraft mill)
Pulp—800 tpd unbleached kraft
Kraft linerboard—1,075 tpd (includes 450 tpd mottled white)

GREEN BAY, WIS.
(Green Bay mill)
Pulp—240 tpd semichemical
Corrugating medium—425 tpd

Total production capacity:

PULP	
Unbleached kraft	800 tpd
Semichemical	240 tpd
Total	1,040 tpd
PAPERBOARD	
Kraft linerboard	1,075
Corrugating medium	425
Total	1,500

Gulf States Paper Corp.

Box 3199
Tuscaloosa, Ala. 35404
J.W. Warner, chairman/chief executive officer

Financial data not available.

In 1988, Gulf States spent approximately $12 million to replace the paperboard machine headbox and add a second brownstock washer line that was started up in December.

The company owns or controls approximately 400,000 acres of U.S. timberland.

Production facilities:

DEMOPOLIS, ALA.
Pulp—700 tpd bleached kraft (75 tpd deinked)
Paperboard—700 tpd bleached coated paperboard

Total production capacity:

PULP	700 tpd
PAPERBOARD	700 tpd

International Paper Co.

2 Manhattanville Rd.
Purchase, N.Y. 10577
John A. Georges, chairman/chief executive officer

(IP owns one-third of Grays Harbor Paper Co. through its acquisition of Hammermill Paper Co.)

Net sales:	
1988:	$9,533,000,000
1987	7,763,000,000
1986	5,500,000,000
1985	4,502,900,000
1984	4,716,000,000
Net income:*	
1988	$754,000,000
1987	407,000,000
1986	305,000,000
1985	133,300,000
1984	120,000,000

* = Reflects extraordinary items.

By the second half of the 1980s, International Paper had completed a major seven-year modernization program in which $5 billion was spent upgrading several of the major southern mills. In addition, IP underwent a major restructuring program, which included the sale of its Canadian operations in 1981, the closure of two containerboard mills and the sale of a third, and withdrawal from the newsprint business. A recent major strategic move was the 1986 purchase of Hammermill Paper Co. for $1.1 billion, expanding IP's position in the higher-value-added, faster-growth white papers.

As a result of the Hammermill acquisition, IP became the world's largest paper company, with 26 pulp and paper mills in the U.S. and two overseas. Among grades produced by the company are uncoated free-sheet, coated papers, bristols, paper and specialty pulp, containerboard, bleached board, and kraft packaging paper.

Net sales by the pulp and paper segment reached $3.1 billion in 1988. Paperboard and packaging sales were $3.3 billion.

In 1988, output of printing/writing papers and bristols was 2.3 million tons; publication paper output was 532,000 tons; and market pulp output reached 1.1 million tons. Production of containerboard was 2.1 million tons; bleached board production was 917,000 tons; and industrial papers production was 634,000 tons.

Capital expenditures in 1988 were $223 million for pulp and paper projects and $220 million for paperboard and packaging projects. IP planned to spend a total of $900 million on capital projects in 1989.

In early 1989, IP added 45,000 tpy of white papers capacity at its Riverdale mill near Selma, Ala. Similar projects are scheduled for mills at Ticonderoga, N.Y.; Georgetown, S.C.; and Mobile, Ala. A $50-million modernization of the Vicksburg, Miss., linerboard mill expanded capacity by about 85,000 tpy. This project, plus planned expansions at the company's other three linerboard mills, will increase annual system capacity by 270,000 tpy.

IP controls 6.5 million acres of timberlands through its majority ownership of IP Timberlands Ltd.

Production facilities:
(IP does not release capacity figures; the following are from published sources or are estimates.)

International Paper Co.

MOBILE, ALA.
Pulp—1,035 tpd kraft
Uncoated free-sheet—1,000 tpd
Packaging/industrial converting paper—85 tpd

CAMDEN, ARK.
Pulp—800 tpd
Packaging/industrial converting paper—715 tpd

PINE BLUFF, ARK.
Pulp—1,600 tpd bleached and unbleached kraft
Publication paper—565 tpd
Solid bleached board—1,150 tpd

BASTROP, LA.
Pulp—1,200 tpd bleached kraft
Printing/writing paper—500 tpd
Solid bleached board—550 tpd

MANSFIELD, LA.
Pulp—2,050 tpd unbleached kraft
Linerboard—1,300 tpd
Corrugating medium—750 tpd

PINEVILLE, LA.
Pulp—975 tpd unbleached kraft
Unbleached kraft board—985 tpd

JAY, MAINE
Pulp—1,200 tpd bleached kraft; 245 tpd groundwood
Printing/writing paper—1,350 tpd

MOSS POINT, MISS.
Pulp—750 tpd kraft
Printing/writing paper—150 tpd
Packaging/industrial converting paper and solid bleached board—785 tpd

NATCHEZ, MISS.
Pulp—650 tpd bleached kraft; 500 dissolving (for market)

VICKSBURG, MISS.
Pulp—1,180 tpd kraft
Unbleached kraft board—1,350 tpd

CORINTH, N.Y.
Pulp—150 tpd groundwood
Printing/writing paper—480 tpd

TICONDEROGA, N.Y.
Pulp—530 tpd bleached kraft
Printing/writing paper—690 tpd

GARDINER, ORE.
Pulp—850 tpd kraft
Unbleached kraft board—850 tpd

RIEGELSVILLE, PA.
(formerly Durham Mill Inc.)
(Mill idle)
Recycled paperboard—375 tpd linerboard, specialty

GEORGETOWN, S.C.
Pulp—1,600 tpd bleached kraft (915 for market)
Uncoated free-sheet—370 tpd
Bleached bristol—345 tpd

TEXARKANA, TEXAS
Pulp—1,300 tpd kraft (estimated 500 tpd for market)
Bleached paperboard—1,300 tpd

MERRILL, WIS.
(Former Ward Paper Co. mill of Arvey Corp.)
Pulp—60 tpd deinking
Fine, specialty papers—100 tpd

Hammermill Paper Div.

SELMA, ALA.
(Riverdale Plant, HPG)
Pulp—1,100 tpd bleached kraft (440 tpd for market)
Uncoated free-sheet—530 tpd

WESTFIELD, MASS.
(Strathmore Paper Co., including facilities at Westfield, Millers Falls, Turners Falls and Woronoco, Mass.)
Printing/writing paper—130 tpd

OSWEGO, N.Y.
Printing/writing paper—210 tpd

HAMILTON, OHIO
(Beckett Paper Co.)
Printing/writing paper—150 tpd

ERIE, PA.
Pulp—680 tpd Neutracel II bleached alkaline (for market)
Printing/writing paper—470 tpd

LOCK HAVEN, PA.
Printing/writing paper—675 tpd

HOQUIAM, WASH.
(Grays Harbor Paper Co., jointly owned)
Printing/writing, related paper—375 tpd

DE PERE, WIS.
(Nicolet Div. of Thilmany Pulp & Paper—former Philip Morris mill)
Paper—140 tpd glassine, greaseproof, release, sanitary waxing

KAUKAUNA, WIS.
(Thilmany Pulp & Paper)
Pulp—430 tpd bleached and unbleached kraft
Packaging industrial converting paper—555 tpd

Total production capacity:

PULP	
Kraft	17,250 tpd
Groundwood	395 tpd
Dissolving	500 tpd
Neutracel	680 tpd
Deinking	60 tpd
Total	18,885 tpd
PAPER	
Printing/writing	5,745 tpd
Uncoated free-sheet	1,900 tpd
Fine	100 tpd
Specialty	140 tpd
Packaging/industrial converting*	2,140 tpd
Bleached bristols	345 tpd
Total	10,370 tpd
PAPERBOARD	
Bleached paperboard	3,000 tpd
Linerboard	1,300 tpd
Unbleached kraft board	3,185 tpd
Corrugating medium	750 tpd
Recycled board	375 tpd
Total	8,610 tpd
TOTAL PAPER AND BOARD	18,980 tpd

* = Includes some solid bleached board

Interstate Resources Inc.

1800 N. Kent St., Suite 1200
Rosslyn, Va. 22209
Fares Korkmaz, acting chief executive officer

Financial data not available.

Interstate produced 225,655 short tons of paperboard in 1988.

The Reading, Pa., mill produced 27,013 short tons of recycled medium in 1988 on its 104-in. cylinder machine and its 67-in. fourdrinier/cylinder machine. It sells on the open market and supplies Interstate container plants in Reading, Pa., and Lowell, Mass.

Total capital expenditures in 1988 were $10.2 million. The company expected to spend $7.4 million in 1989 on projects that include a computerized production monitoring system to control moisture and basis weight.

Production facilities:

RICEBORO, GA.
(Interstate Paper Corp.)
Pulp—530 short tpd kraft
Linerboard—690 short tpd

READING, PA.
(Interstate Intercorr Corp.)
Recycled corrugating medium—100 tpd

Total production capacity:

PULP	530 tpd
PAPERBOARD	
Linerboard	690 tpd
Recycled corrugating medium	100 tpd
Total	790 tpd

Irving Pulp & Paper Ltd.

Box 3007, Station B
Saint John, N.B. E2M 3H1
J.K. Irving, president

Financial data not available.

Following acquisition of the St. John, N.B., mill from Kimberly-Clark Corp. early in 1988, Irving announced it would install a new 60,000-tpy tissue machine at the mill. Startup was scheduled for October 1989.

Production facilities:

SAINT JOHN, N.B.
(Irving Pulp & Paper Ltd.)
Pulp—825 metric tpd bleached and semibleached kraft (for market)

SAINT JOHN, N.B.
(Rothesay Paper Ltd.)
Pulp—525 metric tpd groundwood; 300 tpd thermomechanical
Newsprint—900 metric tpd

SAINT JOHN, N.B.
(Irving Tissue Co., former Kimberly-Clark of Canada mill)
Tissue—40 metric tpd

ST. GEORGE, N.B.
(Lake Utopia Paper Ltd.)
Corrugating medium—225 metric tpd

Total production capacity:

PULP	
Kraft	825 metric tpd
Groundwood	525 metric tpd
TMP	300 metric tpd
Total	1,650 metric tpd
PAPER AND BOARD	
Newsprint	900 metric tpd
Tissue	40 metric tpd
Corrugating medium	225 metric tpd
Total	1,165 metric tpd

ITT Rayonier Inc.

1177 Summer St.
Stamford, Conn. 06904
Ronald M. Gross, chairman/president/chief executive officer

(ITT Rayonier Inc. is a subsidiary of ITT Corp. ITT Rayonier jointly owns two-thirds of Grays Harbor Paper Co. with Hammermill Paper Div. of International Paper Co., which operates the mill and markets its products.)

Net sales (Pulp & Forest Products Div.):	
1988	$1,010,000,000
1987	757,000,000
1986	669,000,000
1985	612,000,000
1984	607,000,000

Although reduced in size, ITT Rayonier is still a major producer of dissolving, paper-grade, and fluff market pulp at three mills (Jesup, Ga.; Fernandina Beach, Fla.; and Port Angeles, Wash.) Of these, the Jesup kraft mill is believed to be the most modern and cost-efficient. The Hoquiam, Wash., pulp mill supplies mainly the adjacent Grays Harbor Paper joint-venture mill. The company has prospered recently from improving markets for dissolving pulp, strong pricing, and reduced production costs at some mills.

Approximately 57% of total sales--$583 million in 1988—are derived from pulp operations. The company produced 870,000 metric tons of pulp in 1988. Capacity in 1989 is 950,000 metric tpy. Capital spending in 1988 was $69 million.

Most timberland properties are owned or leased by Rayonier Timberlands LP, a publicly held master limited partnership of which ITT Rayonier Inc. and Rayonier Forest Resources Co. are general partners. Timberland comprises 1,047,000 acres owned and 139,000 acres controlled.

Production facilities:

FERNANDINA BEACH, FLA.
(Fernandina Div.)
  Pulp—415 tpd sulfite (for market)

JESUP, GA.
(Jesup Div.)
  Pulp—1,470 tpd bleached kraft (for market)

HOQUIAM, WASH.
(Grays Harbor Div.)
  Pulp—370 tpd sulfite

HOQUIAM, WASH.
(Grays Harbor Paper Co.)
  Paper (see International Paper Co.)

PORT ANGELES, WASH.
(Port Angeles Div.)
  Pulp—460 tpd sulfite (for market)

Total production capacity:

PULP	
Sulfite	1,245 tpd
Kraft	1,470 tpd
Total	2,715 tpd

James River Corp.

Box 2218
Richmond, Va. 23217
Brenton S. Halsey, chairman/chief executive officer

(James River owns 80% of James River-Marathon Ltd.; Buchanan Forest Products Ltd. owns 20%. In December 1987, James River completed the purchase of a 50% interest in Kaysersberg S.A. of France.)

Net sales:	
1988	$5,097,978,000
1987	4,479,001,000
1986	2,606,950,000
1985	2,492,009,000
1984	2,301,076,000
Net income:	
1988	$209,010,000
1987	169,864,000
1986	95,288,000
1985	101,351,000
1984	97,995,000

(fiscal year ends April 30)

James River has become one of the largest manufacturers of paper and paperboard through a series of acquisitions made since its founding in 1969. It has concentrated on buying assets at favorable prices in the higher-valued-added, less cyclical segments of the paper industry. The strategy has worked well, and the company has enjoyed one of the highest returns on capital in the paper industry.

In the fiscal year ending in April 1988, hygienics products sales were $1,385.4 million (27% of total sales); communication papers, $1,184.1 million (23%); specialty industrial and packaging papers, $722.4 million (14%); and packaging, $818.9 million (16%). JR sells about 250,000 tons of market pulp, which accounts for 4% of total sales.

Total capital expenditures (including acquisitions) were $623.1 million in fiscal 1988. Of that amount, $461.6 million was spent on paper and other products operations. The company expected to spend $650.0 million in fiscal 1989.

In early fiscal 1988, the Camas, Wash., mill completed a $34-million project to expand bleached kraft pulp capacity. At the Wauna mill at Clatskanie, Ore., a $31.8-million rebuild of a groundwood specialties paper machine was completed in 1989. A new tissue machine was installed at the same mill in November 1988. The company has also approved construction of a secondary fiber plant at Green Bay, Wis.

In June 1988, James River acquired the stock of Ridgway Packaging, which makes folding cartons for food processors and other consumer goods manufacturers. JR completed the purchase of Dunn Paper Co. from Dennison Manufacturing Corp. in May 1987, and it sold the Port Angeles, Wash., mill to Daishowa America Co. in early 1988.

James River acquired 50,000 acres of timberland convenient to the Naheola, Ala., mill in 1987-88, and it has a remaining option to purchase 92,000 additional acres over the next six years. Company policy, however, is to acquire rights to timber cutting rather than ownership. In all, JR owns, leases, or has cutting rights to about 3.2 million acres of timber.

Production facilities:
(James River does not release capacity figures; the following are estimates)

Communication Papers Business

NEWARK, DEL.
(Curtis Mills Div.)
  Cotton papers—24 tpd

ST. FRANCISVILLE, LA.
(Former Crown Zellerbach mill)
  Pulp—633 tpd
  Uncoated free-sheet—249 tpd
  Coated groundwood—521 tpd
  Bristols—99 tpd
  Tissue—8 tpd

ADAMS, MASS.
(Curtis Mills Div.)
  Uncoated free-sheet—35 tpd

HYDE PARK, MASS.
(Hyde Park Div.; being operated by Nolichucky Industries Corp.)
  Pulp—60 tpd deinked
  Specialty paper—196 tpd

YPSILANTI, MICH.
(Curtis Mills Div.)
  Uncoated free-sheet—50 tpd

BERLIN, N.H.
(Pulp Div.)
  Pulp—1,328 tpd

GORHAM, N.H.
(Paper Div.)
  Uncoated free-sheet—319 tpd
  Tissue—160 tpd

GROVETON, N.H.
  Uncoated free-sheet—299 tpd
  Tissue—57 tpd

CLATSKANIE, ORE.
(Wauna Mill, formerly Crown Zellerbach)
  Pulp—284 tpd
  Tissue—248 tpd
  Uncoated free-sheet—249 tpd
  Uncoated groundwood—347 tpd

WEST LINN, ORE.
(Former Crown Zellerbach mill)
  Pulp—65 tpd
  Uncoated groundwood—79 tpd
  Coated free-sheet—59 tpd
  Coated groundwood—347 tpd
  Tissue—11 tpd

CAMAS, WASH.
(Former Crown Zellerbach mill)
  Pulp—1,160 tpd
  Tissue—351 tpd
  Uncoated free-sheet—698 tpd

MARATHON, ONT.
(James River-Marathon Ltd.)
  Pulp—500 metric tpd (551 short)

Packaging Business

KALAMAZOO, MICH.
  Recycled paperboard—475 tpd

Specialty Papers Business

JAY, MAINE
(James River-Otis Div.)
Thin papers—52 tpd

EAST PEPPERELL, MASS.
(James River-Pepperell Inc.)
Specialty paper—78 tpd

FITCHBURG, MASS.
(James River-Fitchburg Div.)
Specialty paper—36 tpd

FITCHBURG, MASS.
(James River-Massachusetts Papermaking Div.)
Specialty paper—161 tpd

WEST SPRINGFIELD, MASS.
(Premoid Div.)
Specialty paper—15 tpd

PARCHMENT, MICH.
(KVP Paper Div.)
Uncoated free-sheet—249 tpd
Coated free-sheet—69 tpd

PORT HURON, MICH.
(Dunn Paper Div.)
Thin papers—157 tpd

ROCHESTER, MICH.
(Filtration Products Div.)
Specialty paper—25 tpd

WIGGINS, MISS.
(Dunn Paper Div.)
Thin papers—57 tpd

MILFORD, N.J.
(Riegel Custom Products Div.)
Specialty paper—154 tpd

HUGHESVILLE, N.J.
(Riegel Custom Products Div.)
Specialty papers—41 tpd

WARREN GLEN, N.J.
(Riegel Packaging Papers Div.)
Specialty papers—70 tpd

BROWNVILLE, N.Y.
(Premoid Div.)
Specialty paper—30 tpd

RICHMOND, VA.
(Filtration Products Div.)
Specialty paper—27 tpd

Towel & Tissue Business

PENNINGTON, ALA.
(Naheola Mill)
Pulp—1,376 tpd kraft
Bleached board—659 tpd
Tissue—628 tpd

OLD TOWN, MAINE
Pulp—1,195
Tissue—212 tpd

BERLIN, N.H.
(Gorham Absorbent Products)
Tissue—162 tpd

CARTHAGE, N.Y.
(Former Crown Zellerbach mill)
Deinked pulp—139 tpd
Tissue—139 tpd

GOUVERNEUR, N.Y.
(Nonwovens Div.)
Tissue—38 tpd

SOUTH GLENS FALLS, N.Y.
(Former Crown Zellerbach mill)
Deinked pulp—183 tpd
Tissue—135 tpd

HALSEY, ORE.
Tissue—270 tpd

ASHLAND, WIS.
Tissue—59 tpd

GREEN BAY, WIS.
Pulp—171 tpd bleached sulfite
Tissue—503 tpd

Total production capacity:

PULP	
Kraft, groundwood	6,592 tpd
Bleached sulfite	171 tpd
Deinked	382 tpd
Total	7,145 tpd
PAPER AND BOARD	
Tissue	2,981 tpd
Uncoated free-sheet	2,148 tpd
Coated groundwood	868 tpd
Uncoated groundwood	426 tpd
Thin papers	266 tpd
Coated free-sheet	128 tpd
Bristols	99 tpd
Cotton-fiber papers	24 tpd
Specialty paper (may include other grades)	833 tpd
Bleached board	659 tpd
Recycled board	475 tpd
Total	8,907 tpd

Jefferson Smurfit Corp.

(Sub. of Jefferson Smurfit Group plc, Ireland)
8182 Maryland Ave.
Jefferson Smurfit Centre
St. Louis, Mo. 63105
Michael W.J. Smurfit, chairman/chief executive officer

[Jefferson Smurfit Group plc holds 78%. JSC owns 80% of Smurfit Newsprint Corp. (Times Mirror Co., 20%); 50% of Container Corp. of America (Morgan Stanley Leveraged Equity Fund, 50%); and 50% of the Monroe, Mich., mill (Monroe Paper Co., 50%).]

Jefferson Smurfit Corp.	
Net sales:	
1988	$1,255,273,000
1987	1,099,465,000
1986	944,356,000
1985	630,425,000
1984	678,112,000
Net income:	
1988	$144,495,000
1987	91,996,000
1986	28,003,000
1985	16,826,000
1984	24,504,000
Container Corp. of America	
Net sales:	
1988	$1,731,190,000
1987	1,535,473,000
1986	1,683,654,000
1985	1,772,356,000
1984	1,892,072,000
Net income:	
1988	$126,557,000
1987	87,071,000
1986	-9,032,000
1985	40,991,000
1984	34,035,000

Jefferson Smurfit Corp. is a major recycler of wastepaper (3.6 million tons in 1988), and it produces recycled paperboard, spiral cores and tubes, and newsprint.

In 1986, the company made three acquisitions worth more than $1.4 billion. The major acquisition gave Smurfit 50% of Container Corp. of America and its nine mills in the U.S. (There are also foreign holdings.) Smurfit has an option to buy the other 50% held by Morgan Stanley in the three years following Sept. 30, 1990. The CCA deal upholds the company's strategy to build core businesses through a combination of acquisitions and internal growth.

In 1988, JSC and CCA had combined net sales of $3.0 billion. Total domestic mill output was approximately 3.4 million tons, comprised of 1.8 million tons of containerboard, 659,000 tons of boxboard, 183,000 tons of solid bleached sulfate, 581,000 tons of newsprint, and 200,000 tons of various grades of recycled cylinderboard. Mill production breaks down as follows: containerboard 53%, boxboard 24%, cylinderboard 6%, and newsprint 17%.

In 1988, JSC/CCA made four acquisitions and had property additions of $100 million. Containerboard capacity is being increased at JSC's Jacksonville, Fla., mill and at CCA's Brewton, Ala., mill. In addition, a third paperboard machine is being installed at CCA's Fernandina Beach, Fla., mill.

JSC/CCA owns or leases 933,000 acreas of timberland in the U.S.

Production facilities:

JACKSONVILLE, FLA.
Pulp—825 tpd unbleached kraft
Kraft linerboard—850 tpd

CEDARTOWN, GA.
Tube stock—60 tpd

ALTON, ILL.
Recycled corrugating medium—620 tpd

LAFAYETTE, IND.
Tube stock, chipboard—125 tpd

MONROE, MICH.
(Smurfit Paperboard)
Tube stock, chipboard—130 tpd

MONROE, MICH.
(Jointly owned with Monroe Paper Co.)
Recycled paperboard—200 tpd (JSC's share: 100 tpd)

LOCKLAND, OHIO
Recycled boxboard—305 tpd

MIDDLETOWN, OHIO
(Boxboard Mill Div.)
Recycled boxboard—315 tpd

NEWBERG, ORE.
(Smurfit Newsprint Co.)
Pulp—510 tpd refiner mechanical; 530 tpd deinked; 40 tpd semibleached kraft
Newsprint—1,050 tpd

OREGON CITY, ORE.
(Smurfit Newsprint Co.)
Pulp—305 tpd thermomechanical; 345 tpd deinked; 35 tpd semibleached kraft
Newsprint—650 tpd

Container Corp. of America:

BREWTON, ALA.
Pulp—1,200 tpd kraft
Unbleached kraft board—815 tpd
Solid bleached board—515 tpd

SANTA CLARA, CALIF.
Recycled board—310 tpd

VERNON, CALIF.
Recycled boxboard—130 tpd
Recycled medium—360 tpd

FERNANDINA BEACH, FLA.
Pulp—2,000 tpd kraft
Unbleached kraft board—2,400 tpd

CARTHAGE, IND.
Recycled medium—130 tpd

WABASH, IND.
Recycled board—340 tpd

CIRCLEVILLE, OHIO
Pulp—250 tpd semichemical
Semichemical corrugating medium—325 tpd

PHILADELPHIA, PA.
Recycled board—450 tpd

TACOMA, WASH.
Recycled board—100 tpd

Total production capacity:

PULP	
Kraft	4,025 tpd
Refiner mechanical	510 tpd
Semibleached kraft	75 tpd
Semichemical	250 tpd
TMP	305 tpd
Deinked	875 tpd
Total	6,040 tpd

PAPER AND BOARD	
Newsprint	1,700 tpd
Linerboard	850 tpd
Kraft board	3,730 tpd
Corrugating medium	1,435 tpd
Recycled board	2,150 tpd
Tube, chipboard	315 tpd
Total	10,180 tpd

Kimberly-Clark Corp.

Box 619100, DFW Airport Station
Dallas, Texas 75261-9100
Darwin E. Smith, chairman/chief executive officer

[Subsidiaries include Kimberly-Clark of Canada Ltd., 100% owned; and Spruce Falls Power & Paper Co. Ltd., 50.5% owned (49.5% by New York Times Co.).]

Net sales:	
1988	$5,393,500,000
1987	4,884,700,000
1986	4,303,100,000
1985	4,072,900,000
1984	3,616,200,000
Net income:	
1988	$378,600,000
1987	325,200,000
1986	269,400,000
1985	267,100,000
1984*	225,000,000

*after $7,400,000 extraordinary gain

Kimberly-Clark manufactures a wide range of products for personal and health care at home and away from home. It also makes technical and specialty papers as well as newsprint and other communication papers. A key strategy is research and development into new technologies and improvement of existing ones, mostly those based on cellulose formation.

Sales of tissue, home and hospital health care products, wipes, and related products totaled $4.2 billion in 1988. Sales of printing/writing papers and technical/specialty/industrial papers were $1.1 billion.

Capital expenditures in 1988 were $438.2 million. The company expected to spend $1 billion on capital projects in 1989.

In early 1989, K-C announced plans to build a commercial/industrial tissue facility at Loudon, Tenn. Completion was scheduled for second-half 1990.

In second-quarter 1988, K-C broke ground for a $150-million greenfield tissue mill at Jenks, Okla. The 68,000-tpy mill will come on line in April 1990. K-C also began a $25-million expansion at the Whiting, Wis., mill. A new 30,000-tpy paper machine and related equipment will be installed, increasing capacity by about 25% when the project is completed in late 1989.

K-C owns 420,000 acres of timberland in the U.S. and leases 48,000 more. In Canada, it manages 11.5 million acres or leases and owns 196,000 acres. The Terrace Bay, Ont., mill is supported by 7.6 million acres of forestland; Spruce Falls is supported by 4.1 million acres.

Production facilities:

COOSA PINES, ALA.
(Coosa River Newsprint)
Pulp—1,200 tpd kraft; 775 tpd groundwood; 120 tpd thermomechanical
Newsprint, groundwood printing paper—1,118 tpd

FULLERTON, CALIF.
Tissue, cellulose wadding—185 tpd

NEW MILFORD, CONN.
Tissue, towels—200 tpd

LEE, MASS.
Cigarette, lightweight specialties—85 tpd

MUNISING, MICH.
(Technical Paper)
Writing, map, specialties—100 tpd

SPOTSWOOD, N.J.
Cigarette plug wrap—130 tpd

ANCRAM, N.Y.
Cigarette plug wrap, technical specialties—15 tpd

BEECH ISLAND, S.C.
Tissue, wadding, towels—270 tpd

MEMPHIS, TENN.
Tissue, wadding, towels—310 tpd

NEENAH, WIS.
(Neenah Paper)
Tissue, wadding, towels—275 tpd

NEENAH, WIS.
Wadding, industrial wipers—60 tpd

WHITING (Stevens Point), WIS.
(Neenah Paper)
Bond, cover, text paper—40 tpd

HUNTSVILLE, ONT.
(Kimberly-Clark of Canada)
Wadding—100 metric tpd (110 short)

KAPUSKASING, ONT.
(Spruce Falls Power & Paper Co. Ltd.)
Pulp—635 metric tpd (700 short) groundwood (K-C's share: 354 short tpd); 381 metric tpd (420 short) thermomechanical (K-C's share: 212 short tpd); 181 metric tpd (200 short) magnefite (K-C's share: 101 short tpd)
Newsprint, groundwood printing—1,025 metric tpd (1,130 short) (K-C's share: 571 short tpd)

ST. CATHARINES, ONT.
(Kimberly-Clark of Canada)
Specialty tissue, lightweight—104 metric tpd (115 short)

TERRACE BAY, ONT.
(Kimberly-Clark of Canada)
Pulp—1,135 metric tpd (1,251 short) bleached kraft (some for market)

Total production capacity:

PULP (short tons)	
Kraft	2,451 tpd
Magnefite	101 tpd
Groundwood	1,129 tpd
TMP	332 tpd
Total	4,013 tpd

PAPER (short tons)	
Newsprint/groundwood specialty	1,689 tpd
Tissue	1,410 tpd
Printing/writing, specialty	155 tpd
Cigarette	230 tpd
Technical	100 tpd
Total	3,584 tpd

Kruger Inc.

3285 Bedford Rd.
Montreal, Que. H3S 1G5
Joseph Kruger II, chairman/chief executive officer

Financial data not available. All sales are derived from paper products.

Kruger is Canada's largest privately owned company in the industry, and it was the first mill to offer newsprint for flexographic printing on a commercial basis.

In 1984, Kruger purchased Bowater Inc.'s Corner Brook, Nfld., mill and began a five-year, C$250-million improvement program. By early 1987, Kruger had completed the rebuild of three machines and planned a fourth for completion in 1989. Plans call for installation of two more thermomechanical pulping lines in 1989. Completing the program, No. 7 newsprint machine, which has been idle, will be rebuilt in 1989; No. 3 will be idled at that time. Mill capacity will be increased by 200 metric tpd to 1,000 tpd. In spring 1988, Kruger announced it would install the 180,000-metric-tpy newsprint machine it has had in storage for several years at Trois Rivières, Que., constructing a building to house No. 10 and completing the project in mid-1990. There may be changes made to the present machines, possibly converting one or two to make SC-B.

Production facilities:

CORNER BROOK, Nfld.
Pulp—300 metric tpd sulfite; 840 metric tpd thermomechanical
Newsprint—915 metric tpd

BROMPTONVILLE, QUE.
(Newsprint Div.)
Pulp—680 metric tpd thermomechanical
Newsprint—570 metric tpd

MONTRÉAL, QUE.
(Turcot Paperboard Div.)
Recycled paperboard—300 metric tpd

TROIS RIVIÈRES, QUE.
Pulp—660 metric tpd groundwood; 540 metric tpd thermomechanical
Newsprint—690 metric tpd
Coated publication paper—392 metric tpd
SC-B—90 metric tpd

Total production capacity:

PULP	
Groundwood	660 metric tpd
Sulfite	300 metric tpd
TMP	2,060 metric tpd
Total	3,020 metric tpd (consumed on site)

PAPER AND BOARD	
Newsprint	2,175 metric tpd
Coated publication	392 metric tpd
SC-B	90 metric tpd
Paperboard	300 metric tpd
Total	2,957 metric tpd

Longview Fibre Co.

P.O. Box 639
Longview, Wash. 98632
R.P. Wollenberg, chairman/president/chief executive officer

Net sales:	
1988	$657,210,000
1987	569,399,000
1986	487,685,000
1985	459,058,000
1984	483,005,000
Net income:	
1988	$96,332,000
1987	65,166,000
1986	33,484,000
1985	22,418,000
1984	22,183,000

(fiscal year ends Oct. 31)

Longview Fibre specializes in kraft linerboard and kraft packaging paper at its big Longview, Wash., mill. About 65% of this output goes to the company's 15 converting plants in ten states. In fiscal 1988, about 88% of Longview's sales were derived from pulp, paperboard, and converting operations. Converted products accounted for the largest amount of sales—nearly 51%.

Sales of paper and board in 1988 reached $248.2 million, and converted products sales were $332.7 million.

In 1988, total primary production of paper and paperboard was 908,000 short tons. The company sold 301,000 tons of paper, 154,000 tons of paperboard, and 546,000 tons of converted products.

Capital expenditures in 1988 were $117.4 million. The company authorized a $90-million project to build No. 12 paper machine over a two-year period. The 300-tpd machine will help meet customer demand for lightweight packaging papers. Total fiscal 1989 spending is budgeted at $120 million.

Longview owns 490,000 acres of timberland and has cutting rights on another 15,000 acres.

Production facilities:

LONGVIEW, WASH.

Pulp—2,760 tpd kraft; 240 tpd semichemical

Packaging, industrial converting paper—1,335 tpd

Unbleached kraft board—1,265 tpd

Semichemical board—200 tpd

Total production capacity:

PULP	
Kraft	2,760 tpd
Semichemical	240 tpd
Total	3,000 tpd
PAPER AND BOARD	
Packaging/industrial converting paper	1,335 tpd
Unbleached kraft board	1,265 tpd
Semichemical board	200 tpd
Total	2,800 tpd

Louisiana-Pacific Corp.

111 S.W. Fifth Ave.
Portland, Ore. 97204
Harry A. Merlo, chairman/president

Net sales*:	
1988	$1,799,400,000
1987	1,654,200,000
1986	1,305,800,000
1985	1,074,900,000
1984	1,027,600,000
Net income**:	
1988	$135,200,000
1987	118,800,000
1986	62,700,000
1985	29,700,000
1984	34,900,000

* Restated to reflect June 1988 spin-off of Fibreboard Corp. subsidiary.

** Before extraordinary items.

Louisiana-Pacific is a major U.S. forest products company with more than 110 building materials plants.

The company's pulp sector accounted for 13% of total sales in 1988. Pulp production was 399,000 short tons, sales were $238 million, and operating profit was $88 million. L-P's two pulp mills operated at 101% of capacity.

In April 1988, the company received $440 million from the federal government for timberland taken in 1978 to expand Redwood National Park. In June, L-P completed the spin-off of its Fibreboard Corp. subsidiary, which is a defendent in thousands of lawsuits alleging injury from asbestos-containing products.

Total capital expenditures in 1988 were $183 million. Of this amount, $17 million was spent on the company's pulp sector.

A $70-million project is under way to increase capacity at the Samoa, Calif., mill by 15% and to improve environmental standards with an oxygen delignification system. In September 1988, L-P announced that it will build a 155,000-tpy bleached chemi-thermomechanical pulp mill near Chetwynd, B.C. Construction was scheduled to be completed in late 1991.

L-P owns 1,600,000 acres of timberland and controls another 600,000 acres.

Production facilities:

KETCHIKAN, ALASKA

Pulp—600 tpd dissolving sulfite (for market)

SAMOA, CALIF.

Pulp—600 tpd bleached kraft (for market)

Total production capacity:

PULP	
Sulfite	600 tpd
Kraft	600 tpd
Total	1,200 tpd

MacMillan Bloedel Ltd.

1075 W. Georgia St.
Vancouver, B.C. V6E 3R9
R.V. Smith, president/chief executive officer

(MB is 49.9% owned by Noranda Forest Inc. It has a 50% interest in Island Paper Mills Ltd.; Noranda Forest has the other 50%.)

Net sales:	
1988	C$3,273,500,000
1987	3,134,500,000
1986	2,511,700,000
1985	2,335,400,000
1984	2,127,600,000
Net earnings:	
1988	C$329,800,000
1987	280,600,000
1986	178,300,000
1985	32,800,000
1984	32,300,000

MacMillan Bloedel is Canada's largest forest products company, with integrated operations in Canada, the U.S., the U.K., and continental Europe. It produces kraft pulp, newsprint, groundwood printing papers, fine papers, containerboard, corrugated containers, lumber, and panelboards. The company is emphasizing a program to reduce costs and stress new, value-added products, including groundwood papers and higher-quality newsprint.

Sales of pulp and paper reached C$1,282.5 million in 1988. Newsprint accounted for $787.4 million; market pulp, $416.2 million; fine papers, $14.1 million; and recycled fiber, $64.8 million. Containerboard and packaging contributed $530.1 million to sales.

In 1988, MB produced 480,000 metric tons of market pulp, 993,000 tons of newsprint and groundwood printing papers, 397,000 tons of linerboard, and 302,000 tons of corrugating medium.

Total capital expenditures in 1988 were C$364.0 million, of which $146.5 million was for pulp and paper operations and $32.8 million was for containerboard and packaging.

A C$100-million project is underway to install a 350-metric-tpd chemi-thermomechanical pulp line at the Port Alberni, B.C., mill. At Powell River, B.C., a $70-million improvement program was completed, boosting production of specialty paper products and lifting total mill capacity to 680,000 metric tpy. The company also announced a $62-million upgrade of the mill's No. 10 paper machine. At Pine Hill, Ala., a US$79-million program to improve linerboard quality was announced. Mill capacity will increase by 70,000 tpy.

MB owns or controls 1,542,000 hectares of timberland in North America.

Production facilities:

NANAIMO, B.C.
(Harmac Div.)

Pulp—1,015 metric tpd bleached kraft (for market)

NEW WESTMINSTER, B.C.
(Island Paper Mills Ltd., jointly owned)
Uncoated free-sheet—410 metric tpd (MB's share: 205 tpd)

PORT ALBERNI, B.C.
(Alberni Pulp & Paper Div.)
Pulp—500 metric tpd unbleached kraft (200 for market); 300 metric tpd bleached kraft; 620 metric tpd groundwood; 75 metric tpd refiner groundwood
Newsprint and/or groundwood specialty—1,090 metric tpd

POWELL RIVER, B.C.
(Powell River Div.)
Pulp—455 metric tpd kraft (90 tpd for market); 700 metric tpd groundwood; 635 metric tpd chemi-thermomechanical
Newsprint/groundwood paper—1,750 metric tpd

STURGEON FALLS, ONT.
Pulp—250 metric tpd semichemical
Corrugating medium—210 metric tpd

PINE HILL, ALA.
(MacMillan Bloedel Inc.)
Pulp—1,100 short tpd (1,000 metric) unbleached kraft; 430 short tpd (390 metric) semichemical
Linerboard—1,165 short tpd (1,055 metric)
Corrugating medium—650 short tpd (590 metric)

Total production capacity:

PULP	
Kraft	3,270 metric tpd
Semichemical	640 metric tpd
Groundwood/RMP	1,395 metric tpd
CTMP	635 metric tpd
Total	5,940 metric tpd
PAPER AND BOARD	
Newsprint/groundwood specialty	2,840 metric tpd
Uncoated free-sheet	205 metric tpd
Linerboard	1,055 metric tpd
Corrugating medium	800 metric tpd
Total	4,900 metric tpd

Macon Kraft Inc.

Box 1551
Rome, Ga. 30161
Timothy L. Campbell, president/chief executive officer

Financial data not available.

In 1987, Pratt Holdings Pty Ltd. of Australia acquired Georgia Kraft Co.'s Macon, Ga., mill from joint owners Mead Corp. and Temple-Inland Inc. A large lumber/plywood manufacturing complex and 200,000 acres of timberland were included in the purchase, but Pratt said it would sell the woodlands and wood products complex to Georgia-Pacific Corp.

The new owner announced plans in late 1987 to invest about $170 million in the mill, spread over several years.

Production facilities:

MACON (Krannert), GA.
Kraft linerboard—1,500 tpd

Total production capacity:

PAPERBOARD	1,500 tpd

Manville Forest Products Corp.

(Sub. of Manville Corp.)
P.O. Box 488
West Monroe, La. 71294-0488
H.W. Sherman, president

Financial data not available.

Manville Corp. filed for protection under Chapter 11 of the federal bankruptcy code in mid-1982. It emerged from bankruptcy on Nov. 28, 1988.

Approximately 83% of Manville Forest Products' sales come from pulp, paper, and paperboard products. The West Monroe, La., mill was a pioneer in developing clay-coated kraft board (solid unbleached sulfate) grades used in beverage carriers and folding cartons. Capacity at the end of 1988 was about 725,000 tpy.

Production of paper and board was 718,600 short tons in 1988. Pulp output was 617,600 tons.

Total capital expenditures in 1988 were $21.3 million, and spending was expected to reach $46.2 million in 1989. In late 1988, the company announced that it would rebuild No. 2 machine.

Manville Forest Products owns 589,000 acres of U.S. timberland and controls another 11,000 acres.

Production facilities:

WEST MONROE, LA.
Pulp—1,700 tpd kraft; 270 tpd semichemical
Kraft paper—125 tpd
Paperboard—1,650 tpd
Corrugating medium—300 tpd

Total production capacity:

PULP	
Kraft	1,700 tpd
Semichemical	270 tpd
Total	1,970 tpd
PAPER AND BOARD	
Paperboard	1,650 tpd
Kraft paper	125 tpd
Corrugating medium	300 tpd
Total	2,075 tpd

Mead Corp.

Courthouse Plaza Northeast
Dayton, Ohio 45463
Burnell R. Roberts, chairman/chief executive officer

[Mead has a 50% interest in Northwood Forest Industries (with Noranda Forest Inc.).]

Net sales:	
1988	$4,463,900,000
1987	4,208,800,000
1986	3,217,700,000
1985	2,740,400,000
1984	2,720,200,000
Net earnings:	
1988*	$364,100,000
1987	216,700,000
1986	36,300,000
1985	93,500,000
1984	139,200,000

* = Reflects $11.4-million loss from discontinued operations

Mead segments include paper, packaging and paperboard, pulp and wood products, converted paper products, distribution, and electronic publishing. The main emphasis, however, is on coated paper and paperboard, and the company has recently divested a number of operations that no longer fit its strategic plan. The purchase of Zellerbach Distribution Group in May 1986 made Mead the largest U.S. integrated distributor of paper. Sixty-one percent of total sales are derived from pulp, paper, paperboard, and converting operations.

In spring 1988, Mead began construction of a new 350,000-tpy coated natural kraft board mill at Mahrt, Ala., adjacent to its Georgia Kraft mill. The greenfield mill will nearly double current capacity for 430,000 tpy of coated paperboard. The $500-million project, the largest Mead has undertaken, will be completed in 1991.

Mead owns 1,638,000 acres of timberland and controls 151,000 additional acres.

Production facilities:

PHENIX CITY (Mahrt), ALA.
(Alabama Kraft Co.)
Pulp—1,000 tpd kraft
Kraft packaging—1,100 tpd

STEVENSON, ALA.
(Alabama Kraft Co.—Paperboard Div.)
Pulp—600 tpd semichemical
Corrugating medium—945 tpd

SOUTH LEE, MASS.
(Specialty Paper Div.)
Specialty paper—70 tpd

ESCANABA, MICH.
(Publishing Paper Div.)
Pulp—600 tpd kraft (300 tpd for market); 200 tpd groundwood
Printing/writing paper—1,300 tpd

CHILLICOTHE, OHIO
(Chillicothe Div.)
Pulp—600 tpd kraft
Coated, carbonless paper—700 tpd

CHILLICOTHE, OHIO
(Chilpaco Mill)
Book, specialty—475 tpd

KINGSPORT, TENN.
(Fine Paper Div.)
Pulp—250 tpd soda
Coated, uncoated paper—550 tpd

MENASHA, WIS.
(Gilbert Paper Co.)
Rag-content, security paper—100 tpd

PRINCE GEORGE, B.C.
(Northwood Forest Industries)
Kraft pulp—1,450 metric tpd (1,600 short) kraft (Mead's share: 800 short tpd)

Total production capacity:

PULP (short tons)	
Kraft	3,900 tpd
Soda	265 tpd
Semichemical	600 tpd
Groundwood	200 tpd
Total	4,965 tpd

PAPER (short tons)	
Printing/writing	3,025 tpd
Rag-content	100 tpd
Specialty	70 tpd
Total	3,195 tpd

PAPERBOARD (short tons)	
Corrugating medium	945 tpd
Natural kraft	1,100 tpd
Bleached board	265 tpd
Total	2,310 tpd

TOTAL PAPER AND BOARD	5,505 tpd

National Gypsum Co.

4500 Lincoln Plaza
Dallas, Texas 75201-3318
J.P. Hayes, chairman/chief executive officer

Financial data not available.

Gypsum board liner and chipboard are produced by the company's Gold Bond Building Products Div.

Production facilities:

ANNISTON, ALA.
Gypsum board liner—208 tpd

STOCKTON, CALIF.
Gypsum board liner—162 tpd
Chipboard—115 tpd

PRYOR, OKLA.
Gypsum board liner—210 tpd

MILTON, PA.
Gypsum board liner—310 tpd

Total production capacity:

PAPERBOARD	
Gypsum board liner	890 tpd
Chipboard	115 tpd
Total	1,005 tpd

The Newark Group Inc.

20 Jackson Drive
Cranford, N.J. 07016
Edward K. Mullen, chairman/chief executive officer

(California Paperboard Corp., Franklin Boxboard Corp., Haverhill Paperboard Corp., Middletown Paperboard Corp., Mobile Paperboard Corp., Natick Paperboard Corp., Newark Atlantic Paperboard Corp., Newark Boxboard Co., Newark Pacific Paperboard Corp., and Wisconsin Paperboard Corp. are all part of the Paperboard Mill Div. of The Newark Group Inc.)

Financial data not available.

In 1988, the company established Newark Pacific Paperboard Corp. within the Paperboard Mill Div. to acquire the clay-coated recycled paperboard mill of Federal Paper Board Co. at Los Angeles, Calif.

Production facilities:

FRANKLIN, OHIO
(Franklin Boxboard Corp.)
Recycled paperboard—165 tpd

HAVERHILL, MASS.
(Haverhill Paperboard Corp.)
Recycled paperboard—300 tpd

LAWRENCE, MASS.
(Newark Atlantic Paperboard Corp.)
Clay-coated recycled paperboard—200 tpd

LOS ANGELES (City of Commerce), CALIF.
(Newark Pacific Paperboard Corp.)
Clay-coated recycled paperboard—165 tpd

MIDDLETOWN, OHIO
(Middletown Paperboard Corp.)
Recycled paperboard—130 tpd

MILWAUKEE, WIS.
(Wisconsin Paperboard Corp.)
Recycled paperboard—420 tpd

MOBILE, ALA.
(Mobile Paperboard Corp.)
Recycled paperboard—180 tpd

NATICK, MASS.
(Natick Paperboard Corp.)
Recycled paperboard—200 tpd

NEWARK, N.J.
(Newark Boxboard Co.)
Recycled paperboard—130 tpd

SANTA CLARA, CALIF.
(California Paperboard Corp.)
Recycled paperboard—300 tpd

Total production capacity:

PAPERBOARD	
Recycled	2,190 tpd

Noranda Forest Inc.

(Sub. of Noranda Inc.)
Suite 4414, P.O. Box 7
Toronto Dominion Bank Tower
Toronto, Ont. M5K 1A1
Adam Zimmerman, chairman/chief executive officer

[Noranda Forest Inc. owns 100% of Fraser Inc. and James Maclaren Industries Inc., 75% of Island Paper Mills Co. (50% directly and 25% through MacMillan Bloedel Ltd.), 50% of Northwood Pulp & Timber Ltd., and 49.9% of MacMillan Bloedel (listed separately in Company

Profiles). Noranda Forest also has a 50% interest in MacMillan Bathurst Inc. (held through MacMillan Bloedel) and a 24% interest in Normick Perron Inc., which in turn has a 42% interest in the Donohue-Normick Inc. joint-venture newsprint mill at Amos, Que.]

Net sales*:	
1988	C$4,715,000,000
1987	4,470,000,000
1986	3,736,000,000
1985	3,400,000,000
1984	3,150,000,000
Net earnings*:	
1988	C$263,000,000
1987	203,200,000
1986	102,700,000
1985	-21,100,000
1984	-2,900,000

* Restated.

Noranda Inc. established its Noranda Forest Inc. subsidiary in 1987 with the amalgamation of Fraser and James Maclaren Industries, following which the shares in MacMillan Bloedel, Northwood Pulp & Timber, and Noranda Forest Sales were transferred to the company, now freestanding.

Approximately 50% of net sales in 1988 came from pulp and paper products; another 12% came from paperboard packaging.

In 1988, total production at Noranda Forest's principal operating interests was 1.2 million metric tons of pulp, 1.4 million tons of newsprint and groundwood papers, 344,000 tons of woodfree papers, and 733,000 tons of paperboard.

Noranda Forest spent C$560 million on capital outlays in 1988—60% of it on pulp and papermaking operations. It is installing an $82-million off-machine coater at the Island Paper Mills facility in order to produce higher-quality, higher-value coated papers. Startup is scheduled for early 1990. At Fraser's Madawaska, Maine, mill, a $68-million modernization of two fine papers machines is intended to give that company a specialized market niche in lightweight book papers. Maclaren is spending $168 million to expand output at its Thurso, Que., bleached hardwood pulp mill by 75,000 metric tpy. Startup is scheduled for mid-1990. Noranda Forest expected to spend $1.0 billion on capital expenditures in 1989—75% of that amount on pulp and papermaking facilities.

Noranda Forest owns 1.7 million acres of timberland in North America. It also controls 9.6 million acres, which includes volume-based cutting rights as well as MacMillan Bloedel's acreage.

Production facilities:

NEW WESTMINSTER, B.C.
(Island Paper Mills Co.)
Uncoated free-sheet—350 metric tpd (Noranda Forest's share: 50% or 175 metric tpd)

ATHOLVILLE, N.B.
(Atholville Pulp Inc.)
Pulp—350 metric tpd magnesium bisulfite (for market)

EDMUNDSTON, N.B.
Pulp—304 metric tpd groundwood; 372 metric tpd bleached softwood sulfite; 463 metric tpd unbleached and semibleached sulfite (all consumed on site)
Paperboard—127 metric tpd coated and uncoated boxboard

THOROLD, ONT.
(Thorold Div.)
Pulp—59 metric tpd deinked
Coated and uncoated free-sheet—250 metric tpd

MADAWASKA, MAINE
(Fraser Inc.)
Uncoated groundwood paper—418 short tpd (379 metric)
Uncoated free-sheet—418 short tpd (379 metric)
Coated paper—430 short tpd (390 metric)

MASSON (Buckingham), QUE.
(James Maclaren Industries Inc.)
Pulp—350 metric tpd groundwood; 235 metric tpd sulfite (all consumed on site)
Newsprint—585 metric tpd

THURSO, QUE.
(James Maclaren Industries Inc.)
Pulp—380 metric tpd bleached kraft (for market)

PRINCE GEORGE, B.C.
(Northwood Pulp & Timber Ltd.)
Pulp—1,475 metric tpd bleached kraft (1,050 for market) (Noranda Forest's share: 738 metric tpd)

Total production capacity:

PULP	
Kraft	1,118 metric tpd
Sulfite	1,420 metric tpd
Groundwood	654 metric tpd
Deinked	59 metric tpd
Total	3,251 metric tpd (1,724 tpd consumed on site)
PAPER AND BOARD	
Newsprint	585 metric tpd
Printing/writing	1,573 metric tpd (including 50% of Island Paper Mills)
Paperboard	127 metric tpd
Total	2,285 metric tpd

Packaging Corp. of America

(Sub. of Tenneco Inc.)
1603 Orrington Ave.
Evanston, Ill. 60204
Monte R. Haymon, president/chief executive officer

Net sales:	
1988	$1,305,000,000
1987	1,153,000,000
1986	953,000,000
1985	854,500,000
1984	799,500,000
Operating income:	
1988	$215,000,000
1987	166,000,000
1986	110,000,000
1985	93,000,000
1984	85,600,000

Packaging Corp. of America made several specialty packaging acquisitions in 1986 in order to become a full-line packaging company. About 51% of company sales come from pulp, paper, paperboard, and converted products.

Much of the containerboard produced at PCA's Counce, Tenn., and Filer City, Mich., mills is converted at the company's 26 U.S. container plants. The Molded Fibre Group operates five plants in the U.S. and two in Europe producing egg, produce, and other special trays. The Aluminum & Plastic Group produces containers from a wide variety of materials.

Pulp, paper, paperboard, and converting operations accounted for sales of $967 million in 1988. Shipments (to outside customers only) of paper and board were 850,000 tons. In addition, 11.6 million ft2 of converted products were shipped.

Total capital expenditures in 1988 were $50.1 million, and spending was expected to reach $69.6 million in 1989.

PCA manages nearly 500,000 acres of forestland.

Production facilities:

MIDDLETON, CALIF.
Molded pulp products—16 tpd

RED BLUFF, CALIF.
Molded pulp products—100 tpd

MACON, GA.
Molded pulp products—85 tpd

GRIFFITH, IND.
Molded pulp products—62 tpd

TAMA, IOWA, and RITTMAN, OHIO
Recycled board—500 tpd together

FILER CITY, MICH.
Pulp—610 tpd semichemical
Corrugating medium—775 tpd

NATCHEZ, MISS. (Mill idle)
Molded pulp products

PLATTSBURGH, N.Y
Molded pulp products—45 tpd

COUNCE, TENN.
(Tennessee River Pulp & Paper Co.)
Pulp—1,600 tpd kraft
Linerboard—2,000 tpd

Total production capacity:

PULP	
Kraft	1,600 tpd
Semichemical	610 tpd
Total	2,210 tpd
PAPERBOARD	
Recycled board	500 tpd
Corrugating medium	775 tpd
Linerboard	2,000 tpd
Total	3,275 tpd

Paperboard Industries Corp.

144 Front St. West, Suite 600
Toronto, Ont. M5J 1G2
C. Ian Ross, president, chief executive officer

(PIC was taken private in early 1988; therefore, no financial data is available for that year. Belkin Inc. was amalgamated into PIC in September of 1986.)

Net sales:	
1987*	C$203,749,000
1986	79,792,000
1985	71,563,000
1984	67,216,000
Net earnings:	
1987*	C$3,012,000
1986	3,228,000
1985	569,000
1984	405,000

(fiscal year ends Aug. 31)
*Includes three months of Belkin Inc. operations

PIC was incorporated in 1980; in 1982, it brought together its four companies, Trent Valley Paperboard Mills being the oldest and the only paperboard manufacturer; and in 1984, PIC was organized into one legal entity. In 1986, the U.S. subsidiary, Paperboard Industries Inc., bought Big M Paperboard Inc. of Palmyra, Mich., which has boxboard capacity of 25,000 metric tpy and is strategically close to the Trent Valley operation. With the Belkin acquisition, PIC became a significant player in collecting wastepaper, manufacturing recycled paperboard, and converting and selling packaging products.

The Trent Valley operation consists of East Mill, over a century old, which produces boxboard on two machines, and West Mill, which dates from 1978 and makes either boxboard or linerboard on one machine.

Production facilities:

BURNABY, B.C.
(Former Belkin Inc. mill)
Paperboard—550 metric tpd containerboard, boxboard

TORONTO, ONT.
(Former Belkin Inc. mill)
Paperboard—410 metric tpd coated linerboard, boxboard

TRENTON (Glen Miller), ONT.
(Trent Valley Div., West and East mills)
Paperboard—330 metric tpd boxboard or linerboard

MONTREAL QUE.
(Former Belkin Inc. mill)
Paperboard—100 metric tpd boxboard, corestock

PALMYRA, MICH.
(Big M Paperboard Inc.)
Recycled paperboard—83 short tpd (75 metric)

Total production capacity:

PAPERBOARD	1,465 metric tpd

Parsons & Whittemore Inc.

666 Third Ave.
New York, N.Y. 10017
Arthur L. Schwartz, president

Financial data not available.

P&W is one of the largest privately owned companies in the North American pulp and paper industry. After a difficult financial period brought on by the 1984-85 industry downturn, the company's condition strengthened with the recovery in pulp prices.

In spring 1988, P&W and Abitibi-Price Inc. announced plans to build jointly a 220,000-metric-tpy newsprint mill near P&W's Alabama River Pulp Co. mill. P&W will be responsible for design and construction of the mill, and Abitibi will operate it. P&W is spending $35 million in a three-year program to add 30,000 metric tpy of bleached kraft pulp capacity.

Production facilities:

CLAIBORNE, ALA.
(Alabama River Pulp Co.)
Pulp—1,100 tpd bleached hardwood and softwood kraft (for market)

NACKAWIC, N.B.
(St. Anne-Nackawic Pulp & Paper Co. Ltd.)
Pulp—675 metric tpd (744 short) bleached hardwood kraft (for market)

Total production capacity:

PULP	1,844 short tpd

Pentair Inc.

1700 W. Highway 36
St. Paul, Minn. 55113
D. Eugene Nugent, chairman/president/chief executive officer

(Wholly owned subsidiaries are Niagara of Wisconsin Paper Corp. and Cross Pointe Paper Corp. Lake Superior Paper Industries is a 50-50 joint venture with Minnesota Power.)

Net sales:	
1988	$823,821,000
1987	789,245,000
1986	623,876,000
1985	534,198,000
1984	545,438,000
Net income:	
1988	$39,842,000
1987	21,860,000
1986	15,228,000
1985	20,058,000
1984	21,245,000
Net sales, paper sector:	
1988	$378,300,000
1987	387,000,000
1986	377,800,000
1985	363,600,000
1984	389,600,000
Operating income, paper sector:	
1988	$50,500,000
1987	9,000,000
1986	18,400,000
1985	22,800,000
1984	37,300,000

Formed in 1966, Pentair has grown through acquisitions of inefficient operations that it turns into autonomous, profitable subsidiaries. The company focuses on higher-value printing/writing and publications papers. It recently sold off two specialty papers mills that it bought from Port Huron Paper Corp. in 1983.

In mid-1988, Pentair combined Miami Paper and Flambeau Paper under the name Cross Pointe Paper Corp. The Lake Superior Paper Industries mill, which came online in late 1987, is the first mill Pentair has been involved in building. The $400-million, 240,000-tpy joint venture between Pentair Duluth Corp. (subsidiary of Pentair Inc.) and Minnesota Paper Inc. (subsidiary of Minnesota Power) gave Pentair entrance into the fast-growing supercalendered paper market.

Pulp and paper accounted for 46% of net sales in 1988. Among the company's wholly owned subsidiaries, 500,000 tons of paper and 180,000 tons of pulp were produced in 1988. LSPI produced 170,000 tons of paper and 70,000 tons of pulp.

The company spent $25 million in 1988 on capital projects for pulp and paper operations. Total capital spending in 1989 is expected to be $75 million, with $50 million dedicated to pulp and paper facilities. Niagara of Wisconsin Paper is building a $38-million pressurized groundwood pulp mill.

Production facilities:

DULUTH, MINN.
(Lake Superior Paper Industries)
  Pulp—295 tpd groundwood
  Supercalendered paper—600 tpd

WEST CARROLLTON, OHIO
(Cross Pointe Paper Corp.)
  Pulp—100 tpd deinked
  Fine papers—285 tpd

NIAGARA, WIS.
(Niagara of Wisconsin Paper Corp.)
  Pulp—215 tpd groundwood
  Printing/publication papers—650 tpd

PARK FALLS, WIS.
(Cross Pointe Paper Corp.)
  Pulp—170 tpd sulfite
  Fine papers—360 tpd

Total production capacity:

PULP	
Deinked	100 tpd
Groundwood	510 tpd
Sulfite	170 tpd
Total	780 tpd
PAPER	
Printing/publication	650 tpd
Fine	645 tpd
Supercalendered	600 tpd
Total	1,895 tpd

Pope & Talbot Inc.

1500 S.W. First Ave.
Portland, Ore. 97201
Peter T. Pope, chairman/chief executive officer

Net sales (revenues):	
1988	$514,980,000
1987	426,908,000
1986	310,228,000
1985	325,203,000
1984	320,042,000
Net income:	
1988	$31,944,000
1987	28,129,000
1986	15,815,000
1985	6,648,000
1984	-558,000

Pope & Talbot has two businesses: wood products and pulp and paper products. Accounting for 57% of company sales, the pulp and paper segment produces bleached kraft pulp, tissue products, and diapers. Recent acquisitions and construction support the company's long-term goal to produce private-label and generic tissue and disposable diapers at low-cost facilities.

In 1988, pulp and paper products contributed $291.6 million in sales and $43.0 million in operating profit. Production of bleached softwood pulp in 1988 was 177,000 tons, and output of consumer tissue products was 132,000 tons. In addition, 142,000 tons of reclaimed paper pulp were produced.

Total 1988 capital expenditures were $61.8 million, which includes $47.5 million for pulp and papermaking facilities. In August 1988, the company purchased four disposable diaper plants from Georgia-Pacific Corp. It also completed construction on a new diaper facility near Atlanta, Ga. Pope & Talbot is studying a possible expansion of the Halsey, Ore., pulp mill that would increase annual capacity from 180,000 tons to 515,000 tons.

Pope & Talbot owns 37,000 acres of timberland in the U.S.

Production facilities:

HALSEY, ORE.
(Pope & Talbot Pulp Inc.)
  Pulp—420 tpd bleached softwood and hardwood kraft (for market)

RANSOM, PA.
(Absorbent Products Div.)
  Pulp—180 tpd deinked
  Tissue—135 tpd

EAU CLAIRE, WIS.
(Absorbent Products Div.)
  Pulp—300 tpd deinked
  Paper—200 tpd tissue, towel

LADYSMITH, WIS.
(Absorbent Products Div.)
  Paper—80 tpd tissue, wadding

Total production capacity:

PULP	
Bleached kraft	420 tpd
Deinked	480 tpd
Total	900 tpd
PAPER	
Tissue	415 tpd

Potlatch Corp.

One Maritime Plaza
San Francisco, Calif. 94111
Richard B. Madden, chairman/president/chief executive officer

Net sales:	
1988	$1,084,000,000
1987	992,077,000
1986	976,373,000
1985	950,323,000
1984	993,910,000
Net earnings:	
1988	$112,364,000
1987	87,623,000
1986	69,943,000
1985	37,669,000
1984	49,631,000

Potlatch is a diversified forest products company that makes bleached paperboard and packaging, coated free-sheet paper, private-label tissue, and lumber and panel products. The company emphasizes high-value-added products that are less vulnerable to economic cycles. Of total sales, 75% is derived from pulp, paper/paperboard, and converted products.

Paper sales in 1988 reached $336.9 million; pulp and paperboard sales were $353.6 million; and tissue sales were $94.6 million.

Potlatch has capacity for 865,600 tpy of bleached kraft pulp, 554,400 tpy of bleached paperboard, 289,200 tpy of printing paper, and 85,400 tpy of tissue and toweling. Pulp output in 1988 was about 869,000 tons. Total paper/paperboard production was approximately 927,000 tons: 283,000 tons of printing paper, 85,000 tons of tissue, and 559,000 tons of paperboard.

Capital expenditures totaled $114.3 million in 1988. Over $92 million of that amount was spent on pulp and paper operations.

In April 1988, a 100,000-tpy free-sheet machine was started up at the Cloquet, Minn., mill to produce 100% coated paper, and a $28-million off-machine coater was installed at the mill in 1989. The company is also studying a pulp capacity increase of 100% at Cloquet.

A new recovery boiler and evaporator added over 150 tpd of pulp capacity at Lewiston, Idaho. An additional $125 million will be spent on the pulp mill's modernization. Machine modifications at Lewiston will allow production of multi-ply paperboard by 1990, and a rebuild or replacement of the mill's oldest tissue machine is being studied.

Potlatch owns 1.5 million acres of timberland in Arkansas, Idaho, and Minnesota.

Production facilities:

McGEHEE, ARK.
(Cypress Bend Pulp Mill)
Pulp—554 tpd bleached kraft (small amount for market)
Bleached paperboard—605 tpd

LEWISTON, IDAHO
(Paperboard Div.)
Pulp—1,308 tpd bleached kraft (some for market)
Bleached paperboard—914 tpd

LEWISTON, IDAHO
(Consumer Products Div.)
Tissue—234 tpd

BRAINERD, MINN.
(Northwest Paper Div.)
Printing paper—359 tpd

CLOQUET, MINN.
(Northwest Paper Div.)
Pulp—509 tpd bleached kraft
Printing paper—433 tpd

Total production capacity:

PULP	2,371 tpd
PAPER AND BOARD	
Printing	792 tpd
Tissue	234 tpd
Paperboard	1,519 tpd
Total	2,545 tpd

Procter & Gamble Co.

1 Procter & Gamble Plaza
Cincinnati, Ohio 45202
Richard R. Nicolosi, vice president, P&G Paper Products
R.E. Cannon, group vice president, P&G Cellulose

(Wholly owned subsidiaries are Procter & Gamble Paper Products Co. and Procter & Gamble Cellulose)

Financial data for P&G's papermaking operations not available.

P&G first entered the pulp and paper business through construction of its Foley, Fla., pulp mill in 1951. In 1957, P&G acquired a company with two tissue mills in the Midwest. It was renamed Charmin Paper and expanded into a national producer with the addition of mills at Mehoopany, Pa. (built 1966); Oxnard, Calif. (acquired from International Paper in 1974); and Albany, Ga. (built in 1971). The company backed its expansion into tissue with an aggressive marketing program and the development of superior products. Charmin was the first producer to commercialize through-air pre-drying of tissue paper, a technology that offers improved softness and absorbency.

The company first entered the disposable diaper market in 1961 when it began to test market its Pampers brand in Peoria, Ill. This brand, along with the Luvs premium diaper introduced in 1976, helped P&G establish a significant position in the disposable diaper market. The company's share, however, has declined from over 70% in the 1970s to about 53% in the first half of 1987. P&G is meeting the challenge in this highly competitive market by introducing product improvements in Ultra Pampers Plus and Luvs Deluxe. The gender-specific Luvs Deluxe was introduced nationally in November 1988 as the latest technology to prevent leakage and improve fit.

The company's tissue mills and diaper converting plants are supplied with pulp by its Foley, Fla.; Grand Prairie, Alta.; and Oglethorpe, Fla., pulp mills (the last built in 1981). In mid-1986, P&G announced it would phase out ammonia-based sulfite pulp production at the Fox River mill in Green Bay, Wis. Pulp for its tissue mills would come from the Alberta facility.

Production facilities:
(Procter & Gamble does not release capacity figures; the following are estimates.)

OXNARD, CALIF.
(Procter & Gamble Paper)
Tissue grades

FOLEY (Perry), FLA.
(Buckeye Cellulose Corp.)
Pulp—1,335 tpd dissolving, fluff, and paper-grade kraft

ALBANY, GA.
(Procter & Gamble Paper)
Tissue grades—500 tpd

OGLETHORPE, GA.
(Buckeye Cellulose Corp.)
Pulp—860 tpd bleached kraft (mainly fluff pulp)

CHEBOYGAN, MICH.
(Procter & Gamble Paper)
Tissue grades—60 tpd

MEHOOPANY, PA.
(Procter & Gamble Paper)
Pulp—sulfite
Tissue grades—750 tpd

MEMPHIS, TENN.
(Buckeye Cellulose Corp.)
Pulp—265 tpd cotton linters

GREEN BAY, WIS.
(Procter & Gamble Paper: East River & Fox River mills)
Pulp—650 tpd sulfite
Tissue grades—1,000 tpd

GRANDE PRAIRIE, ALTA.
(Procter & Gamble Cellulose Ltd.)
Pulp—840 metric tpd (925 short) bleached kraft (partly for market)

Total production capacity:

PULP (short tons)	
Cotton linters	265 tpd
Kraft	3,120 tpd
Sulfite	650 tpd
Total	4,035 tpd
PAPER	
Tissue	2,570 tpd

Quebec & Ontario Paper Co. Ltd.

80 King St., 8th floor
St. Catharines, Ont. L2R 7G2
John E. Houghton, chairman/chief executive officer

(Quebec & Ontario Paper Co. Ltd. and its QNS Paper Co. Ltd. subsidiary are owned by Chicago-based Tribune Co.)

Net sales:	
1988	C$584,409,000
1987	513,712,000
1986	528,176,000
1985	503,876,000
1984	467,611,000
Net income:	
1988	C$74,176,000
1987	67,345,000
1986	31,820,000
1985	33,443,000
1984	7,904,000

Q&O manufactures newsprint and operates the largest newspaper recycling program in Canada. In its quest to become a high-quality, low-cost producer, the company is reducing its number of pulping systems. For example, the Thorold, Ont., mill used four different pulping systems in 1986 and only two in 1988.

Newsprint output in 1988 reached 732,000 metric tons.

Capital expenditures were $86 million in 1988. A 600-metric-tpd thermomechanical pulp mill is under construction at Baie Comeau, Que., replacing the sulfite pulping operation. Startup of the C$130-million facility was scheduled for late 1989. A new flotation deinking plant at the Thorold mill reached its planned capacity in early 1988.

Q&O owns 263,000 acres of timberlands in Canada and controls another 6,185,000 acres.

Production facilities:

THOROLD, ONT.
Pulp—500 metric tpd thermomechanical; 465 tpd deinked news
Newsprint—803 metric tpd

BAIE COMEAU, QUE.
(QNS Paper Co. Ltd.)
Pulp—600 metric tpd thermomechanical; 395 metric tpd groundwood
Newsprint—1,259 metric tpd

Total production capacity:

PULP	
Groundwood	395 metric tpd
TMP	1,100 metric tpd
Deinked news	465 metric tpd
Total	1,960 metric tpd
PAPER	
Newsprint	2,062 metric tpd

Repap Enterprises Inc.

1150 Peel Street, Suite 3200
Montreal, Que. H3B 3V2
George S. Petty, chairman/chief executive officer

[Repap Enterprises is comprised of Miramichi Pulp & Paper Inc., which includes two mills at Newcastle, N.B., and one at Nelson-Miramichi, N.B. (formerly Acadia Forest Products Ltd.); Skeena Cellulose Inc., Watson Island, B.C.; and Midtec Paper Corp., Kimberly, Wis. The company holds approximately an 8% interest in Tembec Inc.]

Net sales:	
1988	C$1,028,000,000
1987	927,000,000
1986	635,500,000
1985	429,300,000
1984	364,300,000
Net earnings:	
1988	C$92,800,000
1987	62,500,000
1986	13,000,000
1985	2,800,000
1984	6,600,000

Repap has developed expertise in buying older mills at bargain prices and making them profitable. The strategy has made the company a significant North American producer of market pulp and coated paper.

The company announced in March 1989 that it will pay the Manitoba government C$132 million for its troubled Manfor Ltd. Repap will convert the existing unbleached kraft pulp and paper mill to bleached kraft pulp, and then will build a second line for a total pulp capacity of 1,700 tpd.

In 1988, Repap had capacity for 825,000 metric tpy of woodpulp: 660,000 tons was softwood kraft and 165,000 tons was groundwood pulp. Coated paper capacity was 635,000 metric tons.

Production in 1988 was 444,000 metric tons of coated paper and 742,000 tons of woodpulp (590,000 tons softwood kraft and 152,000 tons groundwood).

Repap spent C$608 million on capital expenditures in 1988. Construction of a second coated paper machine at the Miramichi mill in Newcastle, N.B., is under way at a cost of US$335 million. Initial production is scheduled for late 1989, and the projected annual capacity will be 250,000 short tons.

Startup of Midtec's US$300-million paper mill in the fall of 1988 made it the largest coated paper mill in the U.S. The Skeena and Miramichi operations produce the pulps necessary to manufacture free-sheet paper.

Repap has acquired the rights to the Alcell pulping process for making hardwood pulp. Alcell uses alcohol instead of sulfur, and it has the potential for small-scale "mini-mills." These mini-mills could be built more cheaply than conventional large-scale kraft mills and can be located closer to forest areas and/or paper mills. Although developed for hardwood pulping, Alcell will probably be adapted to produce softwood pulps as well. The first Alcell commercial-size trial plant was constructed at Miramichi at a cost of C$70 million and started up in March 1989.

Repap has 3.7 million acres of timberland in Canada under lease, 1.8 million acres supplying the Miramichi operations, and 1.9 million acres supplying the Skeena operations.

Production facilities:

KIMBERLY, WIS.
(Midtec Paper Corp.)
Pulp—120 metric tpd groundwood
Coated paper—1,250 metric tpd

NELSON-MIRAMICHI, N.B.
(Miramichi Pulp & Paper Inc.)
Pulp—400 metric tpd groundwood

NEWCASTLE, N.B.
(Miramichi Pulp & Paper Inc.)
Pulp—545 metric tpd kraft
Coated paper—575 metric tpd

WATSON ISLAND, B.C.
(Skeena Cellulose Inc.)
Pulp—1,400 metric tpd bleached kraft (for market)

Total production capacity:

PULP	
Groundwood	520 metric tpd
Kraft	1,945 metric tpd
Total	2,465 metric tpd
PAPER	
Coated	1,825 metric tpd

Rock-Tenn Co.

Box 4098
Norcross, Ga. 30091
A.W. Brown, chairman
Bradley Currey, Jr., president

Financial data not available.

A privately held company, Rock-Tenn had net sales in 1988 of $442 million—up 41% from sales of $314 million in 1987.

Between 1979 and 1988, the company

acquired seven recycled board mills and 28 converting plants with an annual production of 400,000 tons. Rock-Tenn also has converting and distribution facilities for container, folding carton, solid fiber partition, fiber drum, specialty items such as book cover and furniture parts, and plastic products.

Production facilities:

EATON, IND.
Paperboard—140 tpd chipboard

OTSEGO, MICH.
(Former Mead Corp. mill)
Recycled board—230 tpd

CINCINNATI, OHIO
(Former Mead Corp. mill)
Recycled board—130 tpd

DELAWARE WATER GAP, PA.
Paperboard—130 tpd boxboard, clay-coated board

CHATTANOOGA, TENN.
Recycled paperboard—350 tpd

DALLAS, TEXAS
Recycled paperboard—415 tpd

LYNCHBURG, VA.
(Former Mead Corp. mill)
Recycled board—385 tpd

Total production capacity:

PAPERBOARD	1,780 tpd

Scott Paper Co.

Scott Plaza
Philadelphia, Pa. 19113
Philip E. Lippincott, chairman/chief executive officer

(Scott Maritimes Ltd. is a wholly owned subsidiary. In 1986, Scott bought Bowater Industries plc's 50% ownership of Bowater-Scott Corp. Ltd. in a move to strengthen its European operations, and it renamed the unit Scott Paper Ltd.).

Net sales:	
1988*	$4,726,400,000
1987	4,122,000,000
1986	3,437,000,000
1985	3,049,500,000
1984	2,847,300,000

Net income:	
1988*	$400,900,000
1987	233,800,000
1986	186,500,000
1985	201,100,000
1984	187,021,000

* = Reflects sale of Brunswick Pulp & Paper Co.

Scott has honed its operations to two main segments: personal care and cleaning products and coated printing and publishing papers. It is the world's leading manufacturer of sanitary tissue paper products, and the S.D. Warren subsidiary is the largest producer of coated free-sheet in the U.S., with capacity for over 800,000 tpy. Warren also makes uncoated free-sheet and specialty grades such as release papers and pressure-sensitive labels.

Sales by the personal care/cleaning segment were $3,470.3 million in 1988; sales by the printing/publishing papers segment were $1,256.1 million. Scott Paper Ltd. reported net sales of C$313.2 million and net income of $16.2 million in 1988.

Because of growing personal income and stronger economies in other countries, the personal care/cleaning segment, operated by Scott Worldwide, is expanding its global marketing. It launched a $250-million capital investment program in Europe in 1987, and in 1988 it announced a $50-million program for the Pacific region.

S.D. Warren is expanding production of lightweight coated papers, hoping to cash in on the growth of catalogs and specialty magazines. It announced a $475-million program to build a third lightweight coated paper machine at the Somerset mill at Skowhegan, Maine, and to rebuild a large heavyweight coated paper machine at Muskegon, Mich. Startup of the Somerset machine is scheduled for late 1990.

In addition, Scott is refocusing its pulp strategy on eucalyptus, northern softwood kraft, and recycled fibers. In 1988, it purchased, with two other firms, a pulp mill in Chile and 80,000 acres of forestland for growing eucalyptus trees.

Scott owns 2.9 million acres of timberlands in North America.

Production facilities:
(Scott does not release capacity data; information below is estimated and incomplete.)

MOBILE, ALA.
(Southern Operations)
Pulp—1,450 tpd kraft; also deinked
Tissue—750 tpd
Uncoated free-sheet—498 tpd
Coated free-sheet—248 tpd
Cotton-fiber—99 tpd

SKOWHEGAN (Hinckley), MAINE
(S.D. Warren Div., Somerset Mill)
Pulp—900 tpd bleached kraft (300 for market)
Coated free-sheet—1,289 tpd

WESTBROOK, MAINE
(S.D. Warren Div.)
Pulp—295 tpd bleached kraft
Uncoated free-sheet—100 tpd
Coated free-sheet—347 tpd

WINSLOW, MAINE
(S.D. Warren Div.)
Pulp—485 tpd sulfite (pulp mill idle)
Tissue, toweling, waxing, coating-base, specialty—580 tpd
Uncoated free-sheet—100 tpd

MUSKEGON, MICH.
(S.D. Warren Div.)
Pulp—250 tpd bleached kraft
Coated free-sheet—397 tpd

FORT EDWARD, N.Y.
Tissue—180 tpd

CHESTER, PA.
Tissue—1,060 tpd

EVERETT, WASH.
(Northwest Operations)
Pulp—525 tpd sulfite; 30 tpd groundwood
Tissue, towel—600 tpd

MARINETTE, WIS.
Tissue—350 tpd

OCONTO FALLS, WIS. (Mill idle)
Toweling

NEW WESTMINSTER, B.C.
(Scott Paper Ltd.)
Pulp—85 metric tpd (94 short) groundwood
Tissue—300 metric tpd (330 short)

ABERCROMBIE POINT, N.S.
(Scott Maritimes Ltd.)
Pulp—600 metric tpd (662 short) bleached kraft (some for market)

CRABTREE, QUE.
(Eastern Mfg. Div.)
Pulp—90 metric tpd (92 short) deinked
Tissue—100 metric tpd (110 short)

LENNOXVILLE, QUE.
(Eastern Mfg. Div.)
Pulp—45 metric tpd (50 short) deinked
Tissue—45 metric tpd (50 short)

Total production capacity:

PULP (short tons)	
Kraft	3,557 tpd
Sulfite	1,010 tpd
Groundwood	124 tpd
Deinked	142 tpd
Total	4,833 tpd

PAPER (short tons)	
Tissue grades	4,010 tpd
Uncoated free-sheet	698 tpd
Coated free-sheet	2,281 tpd
Cotton-fiber	99 tpd
Total	7,088 tpd

Simpson Paper Co.

(Sub. of Simpson Investment Co.)
One Post St.
San Francisco, Calif. 94104
John Fannon, president

Financial data not available.

Simpson has grown through acquisitions.

In late 1985, it purchased Champion International's unbleached pulp, paper, and linerboard mill at Tacoma, Wash., thus marking a diversification from its white paper and market pulp operations. The mill integrated into Simpson's timber operations, bringing with it 240,000 acres of timberland.

In late 1987, Simpson bought Chesapeake's Plainwell, Mich., mill to boost its output of premium coated printing papers at a site serving eastern markets.

In early 1987, the company bought Champion's coated and uncoated printing/writing papers mill at Pasadena, Texas. In 1989, Simpson approved an $80-million expansion project to boost capacity there by 25%. Startup is scheduled for early 1991.

Production facilities:

ANDERSON, CALIF.
Pulp—230 metric tpd bleached kraft
Printing/writing paper—420 tpd

FAIRHAVEN, CALIF.
Pulp—625 metric tpd bleached kraft (470 for market)

POMONA, CALIF.
Pulp—60 metric tpd deinked
Printing/writing paper—340 tpd

RIPON, CALIF.
Printing/writing paper—20 tpd
Fine papers—70 tpd

PLAINWELL, MICH.
(Simpson Plainwell Paper Co.)
Printing/writing paper—155 tpd
Release liner paper—110 tpd

VICKSBURG, MICH.
Fine papers—80 tpd
Special industrial paper—20 tpd

MIDDLETOWN, OHIO
(Harding-Jones Paper Co.)
Rag-content paper—20 tpd

MIQUON, PA.
Fine papers—130 tpd

PASADENA, TEXAS
(Simpson Pasadena Paper Co.)
Pulp—725 metric tpd bleached kraft
Printing/writing papers—740 tpd

TACOMA, WASH.
Pulp—1,060 metric tpd unbleached kraft (245 for market)
Paper/board—880 tpd bag, multiwall, converting, linerboard

Total production capacity:

PULP	
Kraft	2,640 metric tpd
Deinked	60 metric tpd
Total	2,700 metric tpd

PAPER AND BOARD	
Printing/writing	1,675 tpd
Fine paper	280 tpd
Release liner paper	110 tpd
Rag-content paper	20 tpd
Special industrial	20 tpd
Paper/board	880 tpd
Total	2,985 tpd

Sonoco Products Co.

North Second St.
Hartsville, S.C. 29550-0160
Charles W. Coker, president

Net sales:	
1988	$1,599,751,000
1987	1,312,052,000
1986	963,796,000
1985	869,598,000
1984	740,869,000
Net income:	
1988	$96,277,000
1987	61,482,000
1986	54,676,000
1985	49,409,000
1984	42,535,000

Sonoco is a major manufacturer of packaging products and the world's leading producer of tubes, cores, cones, and uncoated cylinder paperboard. It produces composite cans, fiber drums and partitions, corrugating medium, and other packaging items. It is also one of the world's leading consumers of wastepaper.

Sonoco stresses vertical integration, but grows through acquisitions. In 1987, it purchased Boise Cascade Corp.'s Consumer Packaging Div. (composite cans). In 1988, it bought Federal Paper Board Co.'s recycled boxboard mill at Richmond, Va., which increased Sonoco's recycled paperboard capacity to about 715,000 tpy and made it the largest U.S. producer of this grade.

The U.S. paper sector accounted for $250 million in sales in 1988—16% of the company total. Canadian results are included with the international segment, which had sales of $252 million in 1988.

Sonoco produced about 662,000 tons of uncoated cylinderboard in the U.S. in 1988, which was nearly at capacity. The Hartsville, S.C., mill produced about 158,000 tons of corrugating medium.

Capital spending in 1988 was about $94 million, not including acquisitions. Of this amount, $10 million was spent on the U.S. paper sector, and $15 million was spent on international operations including Canada.

Sonoco owns 20,000 acres of timberland and controls an additional 24,000 acres.

Production facilities:

CITY OF INDUSTRY, CALIF.
Paperboard—70 tpd

ATLANTA, GA.
Paperboard—120 tpd

ROCKTON, ILL.
Paperboard—68 tpd

HOLYOKE, MASS.
Paperboard—234 tpd

AMSTERDAM, N.Y.
Paperboard—57 tpd

LANCASTER, OHIO
Paperboard—90 tpd

MUNROE FALLS, OHIO
Paperboard—74 tpd

DOWNINGTOWN, PA.
Paperboard—159 tpd

HARTSVILLE, S.C.
Pulp—250 tpd semichemical
Corrugating medium—487 tpd
Paperboard—540 tpd

NEWPORT, TENN.
Paperboard—280 tpd

RICHMOND, VA.
(Former Federal Paper Board Co. mill)
Recycled board—195 tpd

SUMNER, WASH.
Paperboard—90 tpd

BRANTFORD, ONT.
(Sonoco Ltd.)
Paperboard—135 metric tpd (149 short)

TERREBONNE, QUE.
(Sonoco Ltd.)
Paperboard—59 metric tpd (65 short)

Total production capacity:

PULP (short tons)	250 tpd (consumed on site)
PAPERBOARD (short tons)	
Paperboard	2,191 tpd
Corrugating medium	487 tpd
Total	2,678 tpd

Southeast Paper Mfg. Co.

Box 1169
Dublin, Ga.
Robert F. Wilson, president

(Southeast is owned equally by Knight-Ridder Inc., Cox Enterprises Inc., and Media General Corp. Media General also owns Garden State Paper Co. Inc.)

Financial data not available.

In 1988, Southeast had net sales of $115.2 million and net earnings of over $25 million. The company produced 221,500 short tons of newsprint.

In September 1989, Southeast was scheduled to complete a $330-million expansion program more than doubling its newsprint capacity to 460,000 tpy. Plans included new deinking facilities and expanded wastepaper reclamation capacity to provide furnish for the new machine. Southeast uses Garden State Paper Co. technology in producing newsprint from recycled newspapers.

Production facilities:

DUBLIN, GA.
Pulp—600 tpd deinked; 50 tpd thermomechanical (not operated full time)
Newsprint—620 tpd

Total production capacity:

PULP	
Deinked	600 tpd
TMP	50 tpd
Total	650 tpd
PAPER	620 tpd

St. Joe Paper Co.

1650 Prudential Drive, Suite 400
Jacksonville, Fla. 32207
J.C. Belin, chairman/chief executive officer

[St. Joe Paper Co. is part of St. Joe Forest Products Co., which in turn is part of St. Joe Industries Inc., one of the two operating divisions created when the company reorganized in 1986. (The other is St. Joe Properties Inc.) St. Joe Forest Products also includes St. Joe Container and St. Joseph Land & Development Co.]

Net sales and operating revenues:	
1988	$651,550,000
1987	596,304,000
1986	508,277,000
1985	483,000,000
1984	512,000,000
Net income:	
1988	82,671,000
1987	57,194,000
1986	100,395,000
1985	44,000,000
1984	52,000,000

St. Joe has operations in five industries: forest products, rail transport, sugar cane production and processing, communications, and real estate.

The forest products division manufactures kraft linerboard, which is used to produce corrugated boxes at the company's 18 box plants. Total 1988 revenue in this division was $394.4 million, and its operating profit was $54.9 million. The company spent a total of $123.5 million on capital improvements in 1988, and $59.5 million of that amount was dedicated to forest products.

St. Joe owns over one million acres of timberland in Florida and Georgia.

Production facilities:

PORT ST. JOE, FLA.
Pulp—1,700 tpd
Kraft linerboard—1,300 tpd

Total production capacity:

PULP	1,700 tpd
PAPERBOARD	1,300 tpd

Stone Container Corp.

150 N. Michigan Ave.
Chicago, Ill. 60601-7568
Roger W. Stone, chairman/president/chief executive officer

(Stone Container acquired Consolidated-Bathurst for C$2.6 billion in March 1989. Con-Bath was renamed Stone Consolidated Inc. on Sept. 1, 1989, and it was given a world product mandate over production and marketing of both companies' newsprint, groundwood specialties, and market pulp operations. The merger creates the second-largest pulp, paper, and paperboard producer in the world, with estimated sales of more than US$6 billion and capacity of approximately 7.5 million short tpy. The listing below covers only Stone Container and its fiscal year 1988.)

Net sales:	
1988	$3,742,489,000
1987	3,232,919,000
1986	2,032,325,000
1985	1,229,148,000
1984	1,244,395,000
Net income:	
1988	$341,786,000
1987	161,324,000
1986	35,415,000
1985	3,778,000
1984	33,657,000

Stone Container has grown from a second-tier player to the largest producer of containerboard and kraft paper in the U.S. through a series of acquisitions. It took advantage of the earlier industry downturn to acquire other companies at favorable prices using leveraged financing. The company held back on capital spending and used the strong cash flow generated by the 1986-87 industry recovery to reduce debt. In the future, however, the company may face significant capital outlays to modernize some of its higher-cost mills.

In 1988, sales of containerboard, paper, and market pulp were $1.2 billion (32% of total company sales).

Capacity for containerboard, paper, and market pulp reached 4.9 million tons in 1988. Production in 1988 totaled 4.7 million tons and breaks down as follows: containerboard, 3.5 million tons; unbleached kraft paper, 687,000 tons; newsprint, 281,000 tons, and market pulp, 261,000 tons.

Capital expenditures in 1988 were $136.6 million.

Stone began a $24-million expansion project at the Uncasville, Conn., recycled corrugating medium mill. A capacity increase to 400 tpd was scheduled to be completed by fall 1989. In 1988, the company created the Stone Savannah River joint venture to undertake a $350-million modernization and expansion at the Port Wentworth, Ga., mill.

Another company, Stone Forest Industries Inc., was formed to acquire Stone Container Corp.'s forest products operations, including 334,000 acres of private-fee timberland included in the 1987 purchase of Southwest Forest Industries, plus plywood, veneer, and lumber plants. Stone Container holds 49% of the shares in the new firm. In accordance with company policy not to own timberlands, about 33,800 acres of non-core assets were sold early in 1988.

Production facilities:

UNCASVILLE, CONN.
Corrugating medium—230 tpd

JACKSONVILLE, FLA.
(Seminole Kraft Corp.)
Pulp—1,470 tpd bleached kraft (Stone's share: 720 tpd)
Linerboard—1,084 tpd (Stone's share: 531 tpd)
Kraft paper—347 tpd (Stone's share: 170 tpd)

PORT WENTWORTH, GA.
Pulp—800 tpd unbleached kraft
Linerboard—981 tpd

HODGE, LA.
Pulp—1,400 tpd unbleached kraft; 300 tpd semichemical
Kraft papers—1,398 tpd
Corrugating medium—382 tpd

ONTONAGON, MICH.
(Formerly Champion International Corp. mill)
Pulp—550 tpd semichemical
Corrugating medium—681 tpd

MISSOULA, MONT.
(Formerly Champion International Corp. mill)
Pulp—1,900 tpd unbleached kraft
Linerboard—1,962 tpd unbleached

COSHOCTON, OHIO
Pulp—600 tpd semichemical
Corrugating medium—859 tpd

YORK, PA.
(Formerly Champion International Corp. mill)
Corrugating medium—268 tpd
Specialty paper/board—118 tpd

FLORENCE, S.C.
Pulp—1,400 tpd unbleached kraft
Linerboard—1,394 tpd
Kraft paper—397 tpd

HOPEWELL, VA.
Pulp—1,000 tpd unbleached kraft
Linerboard—1,182 tpd

SNOWFLAKE, ARIZ.
(Southwest Forest Industries mill)
Pulp—700 tpd kraft; 200 tpd groundwood; 600 tpd deinked news
Newsprint—800 tpd
Kraft linerboard—450 tpd

PANAMA CITY, FLA.
(Southwest Forest Industries mill)
Pulp—660 tpd hardwood or fluff
Linerboard—800 tpd

Total production capacity:

PULP	
Kraft	8,580 tpd
Semichemical	1,450 tpd
Deinked	600 tpd
Groundwood	180 tpd
Total	10,810 tpd
PAPER AND BOARD	
Linerboard	7,300 tpd
Corrugating medium	2,420 tpd
Kraft paper	1,965 tpd
Newsprint	800 tpd
Specialty paper/board	118 tpd
Total	12,003 tpd

Stora Kopparbergs Bergslags AB

Newton Falls Paper Mill Inc.
Box 253
Newton Falls, N.Y. 13666
Leif Smedman, president

Stora Forest Industries
Box 59
Port Hawkesbury, N.S. B02 2V0
Tom R. Hall, president/general manager

(Stora reorganized following its acquisition of AB Papyrus, and in 1987 it placed Newton Falls Paper Mill Inc. under the Papyrus fine paper operations umbrella. Stora Forest Industries was made an independent operation. In fall 1987, Newton Falls Paper Mill and Mohawk Paper Mills Inc. formed a cooperation agreement, with each buying a 40% share in the other's mill.)

Financial data not available.

Newton Falls planned to add No. 1 coated glossy paper to its line in fall 1987 to make up for market share that No. 3 grade is losing to low-cost, high-quality No. 4 grades. At the time of the purchase of shares in Mohawk Paper Mills, Stora announced the partnership mills were engaged in projects to expand capacity to 200,000 tpy of fine paper.

Production facilities:

NEWTON FALLS, N.Y.
(Newton Falls Paper Mill Inc.)
Paper—400 short tpd (363 metric) fine

POINT TUPPER, N.S.
(Stora Forest Industries)
Pulp—440 metric tpd bleached sulfite (for market); 125 tpd high-yield sulfite; 350 tpd groundwood
Newsprint—425 metric tpd

Total production capacity:

PULP (metric tons)	
Sulfite	440 tpd
High-yield sulfite	125 tpd
Groundwood	350 tpd
Total	915 tpd
PAPER (metric tons)	
Newsprint	425 tpd
Fine papers	363 tpd
Total	788 tpd

Temple-Inland Inc.

303 South Temple Drive
Diboll, Texas 75941
Clifford J. Grum, president/chief executive officer of Temple-Inland Inc.
Ben J. Lancashire, executive vice president of Temple-Inland Inc.; president/chairman/chief executive officer of Inland Container Corp.

(Temple-Inland Forest Products Corp. and Inland Container Corp. are wholly owned subsidiaries of Temple-Inland Inc.)

Net sales:	
1988	$1,773,500,000
1987	1,602,700,000
1986	1,295,807,000
1985	1,243,100,000
1984	1,262,900,000
Net income:	
1988	$199,200,000
1987	141,400,000
1986	80,800,000
1985	85,100,000
1984	102,700,000

Container/containerboard
(Inland Container)

Revenues:	
1988	$1,093,100,000
1987	964,200,000
1986	721,700,000
1985	684,200,000
1984	665,300,000
Income before taxes:	
1988	$221,300,000
1987	150,800,000
1986	38,800,000
1985	49,700,000
1984	74,800,000

Pulp/paperboard
(Temple-Inland Forest Products)

Revenues:	
1988	$336,000,000
1987	292,500,000
1986	264,900,000
1985	256,700,000
1984	284,500,000
Income before taxes:	
1988	$82,700,000
1987	53,400,000
1986	29,400,000
1985	19,800,000
1984	46,800,000

Temple-Inland is a forest resource company with major interests in paper, packaging, building products, and financial services. The company's long-term strategy is to be fully integrated; however, due to recent large incremental containerboard expansions, plus projects under way, it will have excess containerboard to sell for several years.

In 1988, the company's Temple-Eastex Inc. subsidiary changed its name to Temple-Inland Forest Products Corp.

The company has capacity for 1,440,000 tpy of linerboard, 480,000 tpy of corrugating medium, and 565,000 tpy of bleached pulp.

Of total Temple-Inland revenues in 1988, Inland Container accounted for 67%, and Temple-Inland Forest Products accounted for 25%. Inland Container makes containerboard and corrugated packaging. Its output of linerboard and corrugating medium in 1988 was 1,836,000 tons. Temple-Inland Forest Products makes bleached paperboard and building materials. It produced 491,000 tons of paperboard and 111,000 tons of bleached pulp in 1988.

Capital expenditures for container and containerboard in 1988 were $155.9 million. Spending for pulp and papermaking operations was $24.7 million.

The company owns 1,755,000 acres of timberlands in the southern U.S. and controls 113,000 additional acres.

Production facilities:

NEWARK, CALIF.
(Inland Container)
Recycled paperboard—175 tpd

ONTARIO, CALIF.
(Inland Container)
Recycled linerboard—575 tpd

ROME, GA.
(Inland-Rome; former Georgia Kraft Co. mill)
Pulp—2,000 tpd unbleached kraft
Linerboard—2,100 tpd

NEWPORT, IND.
(Inland Container)
Corrugating medium—575 tpd

NEW JOHNSONVILLE, TENN.
(Inland Container)
Pulp—375 tpd semichemical
Corrugating medium—575 tpd

EVADALE, TEXAS
(Temple-Eastex)
Pulp—1,550 tpd bleached kraft
Bleached board—1,550 tpd

ORANGE, TEXAS
Pulp—1,400 tpd unbleached kraft
Linerboard—1,400 tpd

Total production capacity:

PULP	
Kraft	4,950 tpd
Semichemical	375 tpd
Total	5,325 tpd
PAPERBOARD	
Bleached board	1,550 tpd
Linerboard	4,075 tpd
Corrugating medium	1,325 tpd
Total	6,950 tpd

Union Camp Corp.

1600 Valley Rd.
Wayne, N.J. 07470
R.E. Cartledge, chairman/president/chief executive officer

Net sales:	
1988	$2,660,918,000
1987	2,361,684,000
1986	2,092,247,000
1985	1,865,871,000
1984	1,973,781,000
Net income:	
1988	$295,146,000
1987	207,483,000
1986	129,934,000
1985	95,092,000
1984	181,451,000

Union Camp bases its strategy on large-scale integrated mills producing linerboard, kraft paper, and white papers. In addition to pulp and paper, UC has woodlands, converted products, chemicals, building products, and land resources operations. Union Camp produces uncoated bond, copy, tablet, duplicating, and offset papers; coated and uncoated bristols; kraft paper; linerboard; and saturating kraft.

Paper and paperboard contributed $1.595 million toward total sales in 1988. Paper and board shipments in 1988 were 1,587,534 tons.

Capital spending totaled $359 million in 1988 ($241 million for pulp and paper projects). In early 1989, Union Camp completed a $173-million modernization/expansion program at its Montgomery, Ala., linerboard mill. The project will increase capacity to 2,400 tpd.

In 1988, the company announced two major capital programs totaling $1.1 billion. The first—a $375-million, three-year modernization program at the Savannah, Ga., mill—includes a 1,300-tpd linerboard machine and retirement of two older machines. The program will increase mill production by 150,000 tpy while reducing direct manufacturing costs by about 12%.

The second program is a $700-million expansion of the Eastover, S.C., uncoated free-sheet mill. When completed in mid-1991, the project will provide an incremental 1,100 tpd, which will ultimately split out at 800 tpd of uncoated free-sheet and 300 tpd of bleached softwood market pulp.

Union Camp owns 1,689,000 acres of timberland.

Production facilities:
(1989 available capacity)

MONTGOMERY, ALA.
Pulp—2,200 tpd kraft
Linerboard—2,300 tpd

SAVANNAH, GA.
Pulp—2,900 tpd kraft
Linerboard—1,400 tpd
Unbleached paper—1,400 tpd

EASTOVER, S.C.
Pulp—700 tpd bleached kraft
Bleached paper—675 tpd

FRANKLIN, VA.
Pulp—2,000 tpd kraft
Bleached paper/board—1,975 tpd

Total production capacity:

PULP	7,800 tpd

PAPER AND BOARD	
Unbleached paper	1,400 tpd
Bleached paper/board	2,650 tpd
Linerboard	3,700 tpd
Total	7,750 tpd

United States Gypsum Co.

(Subsidiary of USG Corp.)
101 S. Wacker Dr.
Chicago, Ill. 60606
Robert J. Day, chairman/president/chief executive officer

Financial data not available.

USG Corp. was organized in January 1985 as the holding company for several operating subsidiaries that manufacture and market products for the building products and industrial processes markets. Gypsum linerboard is included in U.S. Gypsum's Gypsum Products operations; insulation board is part of Wood Fiber operations.

Production facilities:

SOUTH GATE, CALIF.
Gypsum board liner—200 tpd
Saturating felt—70 tpd (Mill idle)

JACKSONVILLE, FLA.
Gypsum board liner—190 tpd

NORTH KANSAS CITY, MO.
Gypsum board liner—130 tpd

CAMDEN, N.J.
Gypsum board liner—130 tpd

CLARK, N.J.
Gypsum board liner—396 tpd

OAKFIELD, N.Y.
Gypsum board liner—105 tpd

GYPSUM, OHIO
Gypsum board liner—105 tpd

OAKMONT, PA.
(Mill idle)
Paper—60 tpd bag and grocery sack

GALENA PARK, TEXAS
Gypsum board liner—175 tpd

Total production capacity:

PAPER AND BOARD	
Gypsum board liner	1,441 tpd
Saturating felt	70 tpd
Paper	60 tpd
Total	1,561 tpd

Virginia Fibre Corp.

51 Locust Ave.
New Canaan, Conn. 06840
R.C. Macauley, chairman/chief executive officer

(Greif Bros. Corp. has a 50% limited partnership interest in Virginia Fibre.)

Net income:	
1988	Not available
1987	$10,448,000
1986	2,935,000
1985	5,000,000
1984	7,900,000

(fiscal year ends Sept. 30)

Virginia Fibre is a major producer of semichemical corrugating medium.

A 1987 capital project saw installation of a new headbox and top wire former on the semichemical medium machine, one of the few such installations on a medium unit.

Production facilities:
(1987 production estimates based on 354 days' operation)

RIVERVILLE, VA.
Pulp—560 tpd semichemical; 170 tpd recycled fiber
Semichemical corrugating medium—730 tpd)

Total production capacity:

PULP	730 tpd
PAPERBOARD	730 tpd

Waldorf Corp.

2250 Wabash Ave., Box 64260
St. Paul, Minn. 55164
Gene Frey, president

Net sales:	
1988	$136,824,000
1987	122,222,000
1986	108,092,000
1985	108,259,000
1984	105,525,000

(fiscal year ends June 30)

Waldorf reappeared as a name in the industry when Trident Associates Inc. bought two mills from Champion International Corp. and created a new company. It chose part of the name of Hoerner Waldorf Corp., which had operated a folding carton division bought by Champion in 1977. Champion had owned the St. Paul, Minn., mill and acquired the Battle Creek, Mich., mill along with St. Regis Corp. In addition to the two mills, Waldorf has six folding carton plants.

In 1988, Waldorf produced 384,594 short tons of paperboard.

Capital expenditures in 1988 were $2.8 million. The company expected to spend $5.5 million on its mills in 1989.

Production facilities:

BATTLE CREEK, MICH.
Recycled board—325 tpd

ST. PAUL, MINN.
Recycled medium—400 tpd
Recycled board—375 tpd

Total production capacity:

PAPERBOARD	
Recycled medium	400 tpd
Recycled board	700 tpd

Weldwood of Canada Ltd.

1055 W. Hastings St., Box 2179
Vancouver, B.C. V6B 3V8
Thomas Buell, chairman/president

[In early 1988, Weldwood got approval from shareholders to purchase Champion International Corp.'s St. Regis Paper Co. (Canada) Ltd., which included Champion Forest Products (Alberta) Ltd. (of which the Hinton, Alta., market pulp mill is a part) and St. Regis Resources Ltd. (oil and gas). In exchange, Champion's share in Weldwood was boosted from 71.8% to 84.6%. Weldwood owns 50% of Cariboo Pulp & Paper Co.; Daishowa-Marubeni International Ltd. owns 50%.]

Net sales:	
1988	C$894,500,000
1987	741,035,000
1986	658,946,000
Net income:	
1988	C$62,000,000
1987	47,592,000
1986	30,037,000

Champion had begun a pulp expansion project at the Hinton, Alta., mill to increase bleached softwood kraft pulp output from 210,000 metric tpy to 424,000 metric tpy.

The C$361-million project was scheduled for late 1989 startup.

Production facilities:

HINTON, ALTA.
Pulp—545 metric tpd kraft (for market)

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.)
Pulp—800 metric tpd bleached kraft
(Weldwood's share: 400 tpd)

Total production capacity:

PULP	945 metric tpd

Westvaco Corp.

299 Park Ave.
New York, N.Y. 10171
David L. Luke III, chairman
John A. Luke, president/chief executive officer

Net sales:	
1988	$2,133,889,000
1987	1,903,606,000
1986	1,811,937,000
1985	1,721,783,000
1984	1,766,267,000
Net income:	
1988	$200,434,000
1987	146,191,000
1986	108,096,000
1985	104,625,000
1984	129,974,000

(fiscal year ends Oct. 31)

Westvaco manufactures a broad range of high-quality papers for graphic reproduction, communications, and packaging in the U.S., and it has packaging interests in Brazil. It is a major manufacturer of consumer and industrial packaging and one of the world's largest producers of envelopes. It also produces specialty chemicals and develops land for commercial and residential use.

Westvaco emphasizes higher-value-added, differentiated products, and it has one of the biggest research and development budgets in the industry—more than $29 million in 1988. The company's new products include papers for high-quality printing and the graphic arts, bleached paperboard to replace glass or plastic packaging, and saturating kraft used in decorative laminates. Westvaco's goal is to double the share of annual sales that comes from competitively distinctive products.

Sales of bleached pulp, paper, and paper products were $1,382.2 million in 1988, and unbleached paper and products sales were $561.5 million.

In 1988, the company produced 108,400 short tons of market pulp and 2,379,700 tons of paper and paperboard.

Capital expenditures in 1988 were $393.0 million. The company spent $290.8 million on bleached pulp, paper, and paper products, and $79.4 million on unbleached paper and products. Capital spending in 1989 was expected to reach $500 million.

Westvaco owns 1,351,700 acres of timberland in U.S.

Production facilities:

WICKLIFFE, KY.
(Fine Papers Div.)
Pulp—956 tpd bleached kraft
Fine papers—575 tpd

LUKE, MD.
(Fine Papers Div.)
Pulp—1,069 tpd bleached kraft
Fine papers—1,400 tpd

TYRONE, PA.
(Fine Papers Div.)
Fine papers—220 tpd

CHARLESTON, S.C.
(Kraft Div.)
Pulp—2,594 tpd unbleached kraft
Paperboard—2,400 tpd

COVINGTON, VA.
(Bleached Board Div.)
Pulp—1,407 tpd bleached kraft; 184 tpd semichemical
Paperboard—1,597 tpd
Corrugating medium—303 tpd

Total production capacity:

PULP	
Kraft	6,026 tpd
Semichemical	184 tpd
Total	6,210 tpd
PAPER AND BOARD	
Fine papers	2,195 tpd
Corrugating medium	303 tpd
Paperboard	3,997 tpd
Total	6,495 tpd

Weyerhaeuser Co.

Tacoma, Wash. 98477
George H. Weyerhaeuser, president/chief executive officer

(Weyerhaeuser Canada Ltd. is a wholly owned subsidiary. Weyco owns 90% of North Pacific Paper Corp.; Jujo Paper Co. Ltd. of Japan owns 10%.)

Net sales:	
1988	$7,862,505,000
1987	6,989,829,000
1986	5,652,029,000
1985	5,205,579,000
1984	5,549,738,000
Net earnings:	
1988	$515,796,000
1987	379,015,000
1986	179,645,000
1985	131,678,000
1984	174,502,000

Weyerhaeuser Co. is composed of three principal business groupings: Weyerhaeuser Forest Products Co., Weyerhaeuser Paper Co., and Diversified Businesses. It also has interests in real estate and financial services. Paper Co. strategy in recent years has been to build new capacity rather than to buy it. Its paper mills are almost totally integrated, reducing exposure to market pulp prices.

Paper Co. net sales totaled $3.5 billion in 1988, and operating earnings were $737 million. Sales of pulp accounted for $821 million; newsprint, $343 million; paper, $620 million; and paperboard and containerboard, $316 million.

In 1988, output of pulp reached 1,323,000 metric tons; newsprint, 477,000 metric tons; paper, 787,000 short tons; paperboard, 173,000 short tons; and containerboard, 2,093,000 short tons.

Paper Co. capital expenditures in 1988 were $375 million.

In August 1988, a new 210,000-tpy uncoated free-sheet machine was started up at Weyerhaeuser Canada Ltd.'s Prince Albert, Sask. facility. The mill fits into a larger strategy of shifting emphasis to less volatile, higher-margin segments of the printing/writing papers market. Weyco is building a $400-million, 425,000-tpy bleached pulp mill at Columbus, Miss., in an effort to maintain its position as the world's number one supplier of market pulp. Startup is scheduled for mid-1990. The company also announced plans to install a third newsprint machine at Longview, Wash.

Weyerhaeuser owns approximately 5.8 million acres of commercial forestland in the U.S. (50% in the South and 50% in the Northwest), and it has long-term licensing arrangements for about 13 million acres in Canada.

Production facilities:

COLUMBUS, MISS.
Pulp—260 tpd thermomechanical
Lightweight coated paper—521 tpd

NEW BERN, N.C.
Pulp—725 tpd bleached kraft (for market)

PLYMOUTH, N.C.
Pulp—970 tpd kraft (264 for market); 220 tpd semichemical
Containerboard—1,020 tpd
Uncoated free-sheet—927 tpd

VALLIANT, OKLA.
Pulp—1,600 tpd kraft; 400 tpd semichemical
Linerboard—1,980 tpd
Corrugating medium—570 tpd

NORTH BEND, ORE.
Pulp—300 tpd semichemical
Corrugating medium—470 tpd

SPRINGFIELD, ORE.
Pulp—1,090 tpd kraft
Containerboard—1,400 tpd

COSMOPOLIS, WASH.
Pulp—450 tpd sulfite (for market)

EVERETT, WASH.
Pulp—395 tpd kraft (for market)

LONGVIEW, WASH.
Pulp—750 tpd kraft (some for market); 200 tpd semichemical
Corrugating medium—255 tpd
Bleached paperboard—540 tpd

LONGVIEW, WASH.
(North Pacific Paper Co.)
Pulp—1,450 tpd thermomechanical
Newsprint—1,300 tpd

LONGVIEW, WASH.
(R-W Paper Co.)
Uncoated free-sheet—359 tpd

ROTHSCHILD, WIS.
Pulp—210 tpd sulfite
Uncoated free-sheet—349 tpd

KAMLOOPS, B.C.
(Weyerhaeuser Canada Ltd.)
Pulp—1,135 metric tpd (1,250 short) kraft (for market)

PRINCE ALBERT, SASK.
(Prince Albert Pulp & Paper, div. of Weyerhaeuser Canada Ltd.)
Pulp—900 metric tpd (992 short) bleached kraft (for market)
Uncoated free-sheet—600 metric tpd

Total production capacity:

PULP	
Kraft	7,772 tpd
Semichemical	1,120 tpd
Sulfite	660 tpd
TMP	1,710 tpd
Total	11,262 tpd
PAPER AND BOARD	
Uncoated free-sheet	2,235 tpd
Lightweight coated	521 tpd
Newsprint	1,300 tpd
Bleached paperboard	540 tpd
Linerboard	1,980 tpd
Corrugating medium	1,295 tpd
Containerboard	2,420 tpd
Total	10,291 tpd

Willamette Industries Inc.

3800 First Interstate Tower
Portland, Ore. 97201
William Swindells, chairman/president/chief executive officer

Net sales:	
1988	$1,716,021,000
1987	1,431,624,000
1986	1,200,155,000
1985	1,152,067,000
1984	1,181,910,000
Net earnings:	
1988	$161,087,000
1987	121,339,000
1986	74,665,000
1985	60,244,000
1984	61,021,000

Willamette is a producer of containerboard, kraft paper, uncoated free-sheet, and market pulp. Most of its production is converted at its own plants into corrugated boxes, kraft sacks, and business forms. In addition, the company manufactures lumber, plywood, and particleboard.

Willamette's pulp and paper sales were about $329 million in 1988—19% of total sales. Total pulp and paper production was 1,414,000 tons—close to company capacity of 1,431,000 tons.

Total capital expenditures in 1988 were $278.3 million. In June, the company broke ground for a 200,000-tpy uncoated free-sheet paper mill at Bennettsville, S.C. Initially, the Marlboro mill will have capacity for 625 tpd of forms bond and copy papers on one machine, and eventually it will be rated for 1,250 tpd. Startup is scheduled for 1990. In October 1988, a new business forms plant began operation at Rock Hill, S.C. The following month, a machine modernization was completed at the Red River mill at Campti, La., expanding linerboard capacity by 17%.

Willamette owns or controls 1 million acres of timberland in the U.S.

Production facilities:

PORT HUENEME, CALIF.
Recycled paperboard (corrugating medium, linerboard)—408 tpd

HAWESVILLE, KY.
(Kentucky Mills: bleached pulp, fine paper)
Pulp—735 tpd bleached hardwood kraft (350 tpd for market)

HAWESVILLE, KY.
(Kentucky Mills: corrugating medium)
Pulp—300 tpd semichemical
Corrugating medium—385 tpd

HAWESVILLE, KY.
(Kentucky Mills: fine paper)
Fine paper—518 tpd

CAMPTI, LA.
(Red River Mill Div.)
Pulp—800 tpd unbleached kraft
Kraft linerboard—1,079 tpd

ALBANY, ORE.
Pulp—580 tpd kraft; 200 tpd semichemical
Kraft linerboard, paper—900 tpd
Corrugating medium—285 tpd

Total production capacity:

PULP	
Kraft	2,115 tpd
Semichemical	500 tpd
Total	2,615 tpd
PAPER AND BOARD	
Fine paper	518 tpd
Kraft linerboard, paper	1,979 tpd
Corrugating medium	670 tpd
Recycled linerboard, medium	408 tpd
Total	3,575 tpd